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JUNE, 1961

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TEXACO DIESEL DATA

HOW TO SPOT FUEL INJECTOR PROBLEMS

The fuel injector is a most important and complex part of a diesel engine. The effects of a badly adjusted fuel injector can run all the way from increased fuel and lubricant consumption to ring and bearing failures.

Here are some of the characteristic symptoms you'll get if your fuel injector is acting up, and what the most likely cause of each symptom is.

1. **Symptom:** Heavy black smoke at exhaust; loss of power; rough idling.
Probable Cause: Incomplete combustion, due to worn injector nozzle.

2. **Symptom:** Rough, noisy engine; stuck or broken rings; bearing failure in most severe instances.
Probable Cause: Pre-ignition, resulting from premature fuel injection. Causes extreme high temperatures and pressures in combustion chamber.

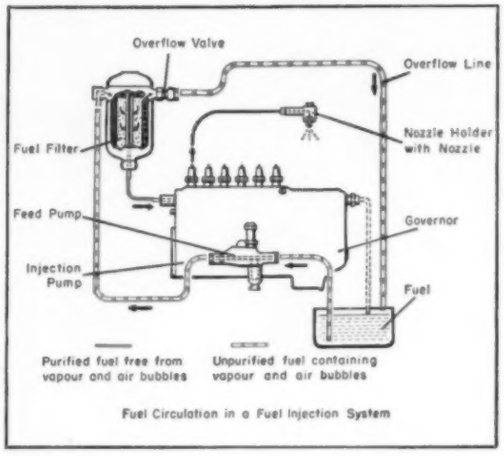
3. **Symptom:** Smoky exhaust; heavy soot deposits in engine and crankcase oil.
Probable Cause: Incomplete combustion due to late injection.

4. **Symptom:** Premature ring wear in some cylinders, heavy varnish formation in other cylinders; engine sounds uneven under load; white or light-blue smoke when engine is idling; dilution of lube oil.
Probable Cause: Improperly equalized injectors, which pump too much fuel into certain cylinders, starve others. "Over-fed" cylinders do most of the work.

Some of these symptoms can be cured with a comparatively minor adjustment; others require more involved techniques.

Improperly equalized injectors, especially on large engines, can be double-checked by a speed-drop test. This involves cutting out one cylinder at a time while you're checking the engine speed with a tachometer. The speed will fall off the most when you cut out the cylinders that are getting the most fuel.

Some folks try to get more power out of an engine by injecting more fuel than the engine was designed to take. You do get more power this way, but it's at the expense of your rings and bearings, and the exhaust becomes excessively smoky. The following chart shows the increase of ring temperature and exhaust smoke on a 4-cycle diesel experimentally overloaded with fuel:



Fuel Circulation in a Fuel Injection System

Fuel/Air ratio	% rated load	BMEP	% exhaust smoke*	Ring groove temperature
.03	67	51	7	336
.04	100	76	7	372
.05	112	85	16	396
.06	114	87	69	402
.07	113	86	92	397
.08	111	84	97	388

*Smokemeter reading.

Because a fuel injector is as carefully built as a good watch, it's best to let your manufacturer's service orgánization help you out with maintenance and repair problems. The most valuable type of preventive maintenance the diesel operator can do is to keep the injector clean. That means no disassembling of the unit in a dusty or otherwise contaminated atmosphere. It also means that you must use nothing but *clean* fuel. Contaminated fuel can ruin a fuel injector nozzle within a few days. You have to be particularly cautious if your injector isn't equipped with a dependable fuel filter. Water in the fuel is objectionable too, not only because it gives uneven engine operation but because it promotes corrosion of valve parts.

Fuel injector problems are best handled by trained experts. The same is true of diesel fuel and lubrication problems. Texaco has many, many years' experience in fueling and lubricating diesel engines of all sizes, in all types of operations. If you're having a problem with diesel fuel or lubricants, contact Texaco Inc., 135 East 42nd Street, New York 17, N. Y.

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Spicer's new Model 7041 4-Speed Auxiliary Transmission—for use in conjunction with standard 4 or 5-speed transmissions—has a nominal torque rating of 550-600 ft. lbs., thus narrows the gap between the Model 6041 (375-400 ft. lbs.) and the 8341 (750-900 ft. lbs.)

New Spicer 4-Speed Auxiliary Transmission For Engines in the 400-600 Ft. Lbs. Torque Range

Model 7041 Broadens Range of Spicer Line, Utilizes Maximum H.P., Is Quiet, Saves Weight

Now—Spicer has added a new model to its power line of 4-speed auxiliary transmissions—the Model 7041—whose 550-600 ft. lbs. nominal torque rating meets a vast need for engines developing over 400 ft. lbs. of torque.

The 7041 operates most effectively with main transmissions in the 400-600 ft. lbs. capacity range. Ratios in the auxiliary are spaced so that they functionally split or compound the ratios of the main transmission.

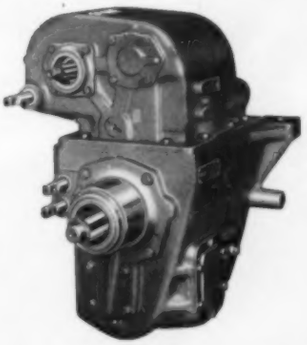
The new transmission has good splits in the top three gears, as the following table shows:

RATIOS	Model	1st	2nd	3rd	4th
	7041	2.31	1.21	1.00	.83

The result is that it is possible to utilize the maximum horsepower of the engine during shifts. In addition, the driver is able to complete shifts in these three splitter gear positions at the same R.P.M.

The new auxiliary transmission is also constant mesh in all gear positions, which makes for quieter operation and easier shifting due to the use of helical gears throughout. It is lighter and less bulky than any other 4-speed auxiliary transmission of similar capacity.

For complete data on the many advantages of the new Spicer 7041, write to Dana Corporation, Toledo 1, Ohio.



Spicer Top Mount Power Take-Off can readily be assembled to the 7041 Auxiliary Transmission by merely removing the cover, is ideal for operating air compressors, heavy-duty winches, large pumps, and other materials handling devices requiring full engine torque.

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CONTENTS FOR JUNE, 1961

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FRONT COVER ILLUSTRATION

Solar Saturn gas turbine drives new Western RB-180 triple fracturing oil fracturing rig. For more on turbine and rig see page 41.

GET REAL PRODUCTIVITY—GET A GM DIESEL

One look will tell you that this Ingersoll-Rand 315 Gyro-Flo compressor has had to work for a living.

And worked it has!

For over 9 years it has been on the job day in, day out, supplying air for drills and hammers in the Halquist Lannon Stone Company quarry near Sussex, Wisconsin.

In those nine years this GM Diesel powered unit has racked up over 40,000 hours—*been overhauled only twice* at approximately 18,000-hour intervals.

Mr. A. C. Halquist says, "The GM Diesel 3-71 in this compressor has had only minor adjustments in addition to two overhauls and still runs as good as new. It's one of the best pieces of equipment we ever bought."

If that's the kind of profit-making productivity you want from your equipment, specify a GM Diesel engine when you buy or repower. There's a model of the proper size and output for nearly every type of construction equipment.

For details see your GM Diesel Distributor* or write direct for your copy of the new booklet, "2300 Applications of GM Diesel Power."

**Listed in the Yellow Pages under "Engines, Diesel."*

GM DIESEL

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Make your Power Takeoff Unit an integral part of the power package—and it will be in the best location to take maximum engine horsepower.

That's what our studies showed us—and that's what the new Clark flywheel PTO can give you.

There are other important advantages, too, with this new-type gear-driven unit.

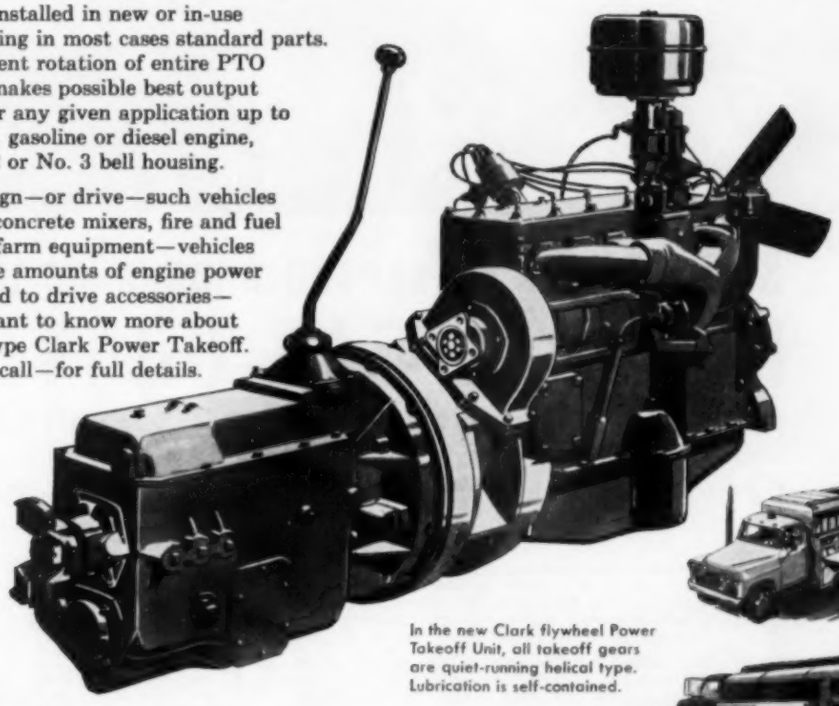
Located between engine flywheel and transmission clutch, it can be operated *at any transmission speed*, or independent of the transmission.

It eliminates auxiliary engines or complicated drive systems—yet adds only eight inches of length to the power plant.

It has a built-in vibration dampener which prevents transmission or torsional impulses into the drive.

It can be installed in new or in-use vehicles using in most cases standard parts. 30° increment rotation of entire PTO assembly makes possible best output location for any given application up to 100 hp . . . gasoline or diesel engine, SAE No. 2 or No. 3 bell housing.

If you design—or drive—such vehicles as transit concrete mixers, fire and fuel trucks, or farm equipment—vehicles where large amounts of engine power are required to drive accessories—you will want to know more about this new-type Clark Power Takeoff. Write—or call—for full details.



In the new Clark flywheel Power Takeoff Unit, all takeoff gears are quiet-running helical type. Lubrication is self-contained.

CLARK EQUIPMENT

CLARK EQUIPMENT COMPANY
AUTOMOTIVE DIVISION
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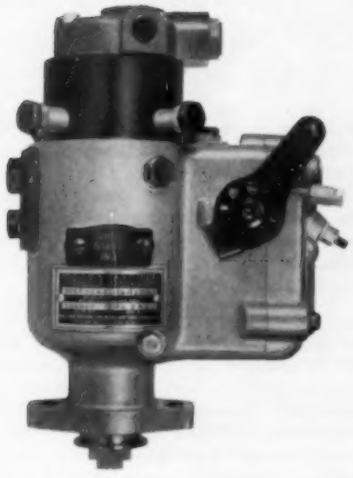

PROGRESS THROUGH SIMPLICITY

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If you have a problem in ring application, avoid further needless expense and delay. Let us know the type of service (diesel, natural gas engine, dual fuel, compressors, etc.), along with the make and model of the equipment. Our engineers will send you the recommended set-up promptly. Write to: KOPPERS COMPANY, INC., Piston Ring and Seal Department, 6206 Scott Street, Baltimore 3, Maryland.

Koppers Porous Chromium-Plated Compression Rings are used extensively in many types of engines and compressors. Intensive tests have demonstrated that chromium-plated rings in the first or first and second grooves reduce cylinder wear one-quarter to one-third of that experienced with unplated rings. Where operating conditions or dimensional tolerances require a ring that will adapt itself readily to the cylinder, porous chrome-plated compression rings are the most popular type. For special conditions, Koppers also makes available dense, threaded or grooved face chromium-plated rings.

The **Koppers Tapered Ring** has a taper on its outside face of either 1° or 2°, depending on the size of the ring. It is used in gasoline, aircraft, gas and diesel engines, and in compressors because it seats-in more rapidly than other standard compression rings. This advantage makes it especially applicable to hardened or chromium-plated cylinders. In out-of-round or distorted cylinders, its ability to seat-in quickly helps prevent blow-by. It may be used in as many compression ring grooves on a piston as necessary; but, ordinarily, when a quick-seating ring is required for the top groove, a Grooved Back Ring or other special ring is used.

The **Koppers Seal Ring** has one band of bearing bronze rolled into a groove on its face. This band projects approximately .004" beyond the face of the cast iron ring. The ring seats quickly because high unit pressure is exerted on the narrow bronze band, preventing blow-by in new or worn cylinders. As the bronze wears, it burnishes the cylinder wall to a mirror-like surface and allows the cast iron body of the ring to reach a seat very gradually. Throughout the life of the ring, the bi-metallic surface serves more effectively to eliminate scuffing, improve lubrication, and reduce wear on cylinder, rings and piston. This ring may be designed to employ two bronze bands if specified.

The **Koppers Grooved Oilcutter Ring** has a continuous channel around its outside face and a series of slots extending through the ring from the base of the channel; and the upper edges of the bearing surfaces are beveled to ride over the oil film on the upstroke. The lower sides of its scraping edges are undercut to form in each a small oil-collecting groove. The oil caught by the upper scraping edge drains through the slots in the ring. The oil caught by the lower scraping edge drains down the cylinder and through holes drilled through the piston from a drainage groove beneath the oil ring groove. The unit pressure of the ring keeps more nearly uniform; consequently, the efficiency of the ring is more constant.

The outer element of the **Koppers Conformable Grooved Oilcutter Ring** is made of cast iron sufficiently thin in cross section to permit maximum flexibility. The inner element is a coiled steel expander spring, the ends of which are butted together. Closed to cylinder size, the spring exerts uniform radial pressure against the ring, forcing it to conform to the cylinder wall although that surface may be neither round nor true. The spring has a low spring rate in order to prevent any appreciable change in pressure as the ring wears. The Conformable Oil Ring maintains a high unit pressure, uniformly distributed, throughout the life of the ring, providing better oil control. For certain four cycle engines, Koppers provides a notched Conformable Grooved Oilcutter Ring to provide more positive oil drainage.

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2460 HORSEPOWER
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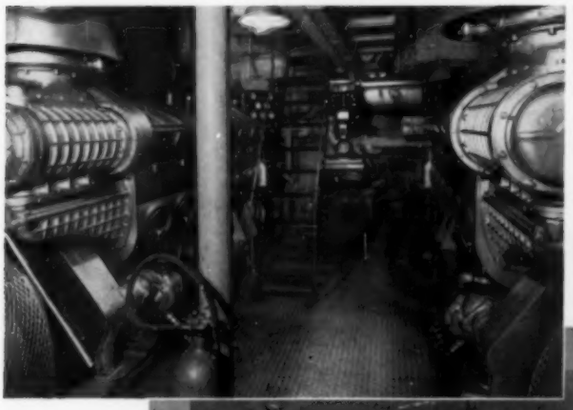
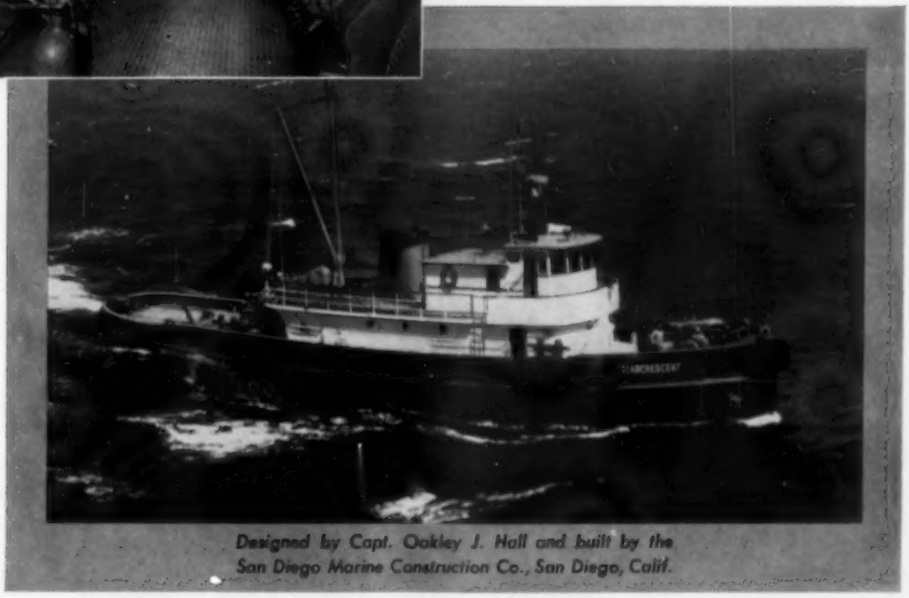
CLEVELAND DIESEL GM

Engine room showing two GM 12-cylinder 567C Diesel engines.



The twin screw tug, STARCRESCENT, owned and operated by the Star Crescent Companies, is the most powerful commercial tug to be built on the West Coast. The STARCRESCENT, powered with two General Motors model 567C Diesel engines, tows lumber barges from the Pacific Northwest to ports in California. This 2460 horsepower twin screw tug, designed tor maximum towing speeds in open waters, has excellent maneuverability in docking barges.



Designed by Capt. Oakley J. Hall and built by the San Diego Marine Construction Co., San Diego, Calif.

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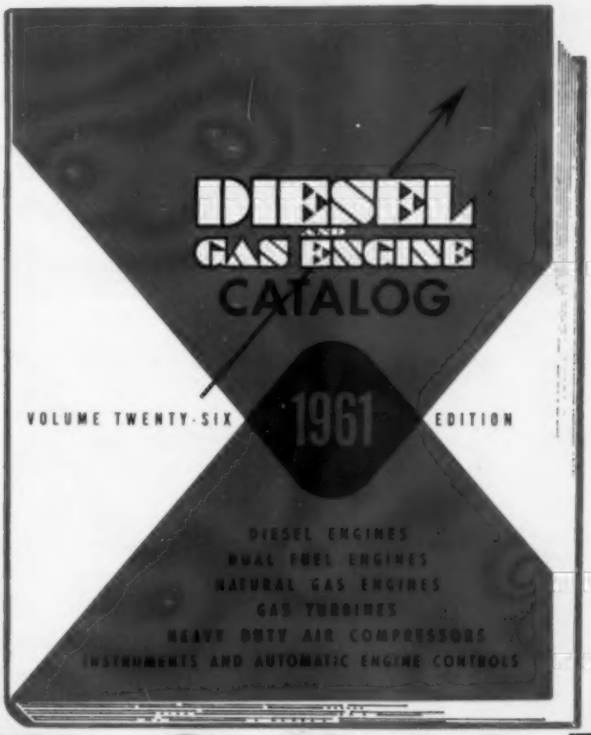

If you design, purchase, sell, operate or service diesel, dual fuel, natural gas engines or gas turbines — **Here is important information for you!**

LOOK AT THE CONTENTS!

1. ENGINES—All major manufacturers of diesel, dual fuel, natural gas engines and gas turbines are represented in multiple page sections. Text is supplemented with specifications, power curves, photographs and sectional views.

2. TURBOCHARGERS and SUPERCHARGERS—This section of manufacturers is detailed and fully illustrated to give complete information on this increasingly important phase of the industry.

3. TRANSMISSIONS—The latest information on torque converters, fluid drives, and other modern means of transmitting power are fully described and illustrated in this section.

4. ACCESSORY EQUIPMENT—Recent developments in fuel injection systems, governors, and other key accessory units are detailed and illustrated fully in this section.

5. AIR/GAS HEAVY DUTY COMPRESSORS—This section deals with heavy duty compressors of all types applicable to all industry and petroleum services.

6. INSTRUMENTS and AUTOMATIC ENGINE CONTROL—This section covers just what the title states.

7. GAS TURBINES—This section is devoted to the gas turbines currently on the market, both in this country and abroad.

8. ADVERTISING—Leading manufacturers of engines, accessories, and services bring out the important features of their products in attractive, easy to read advertisements to further enhance the reference value of the CATALOG.

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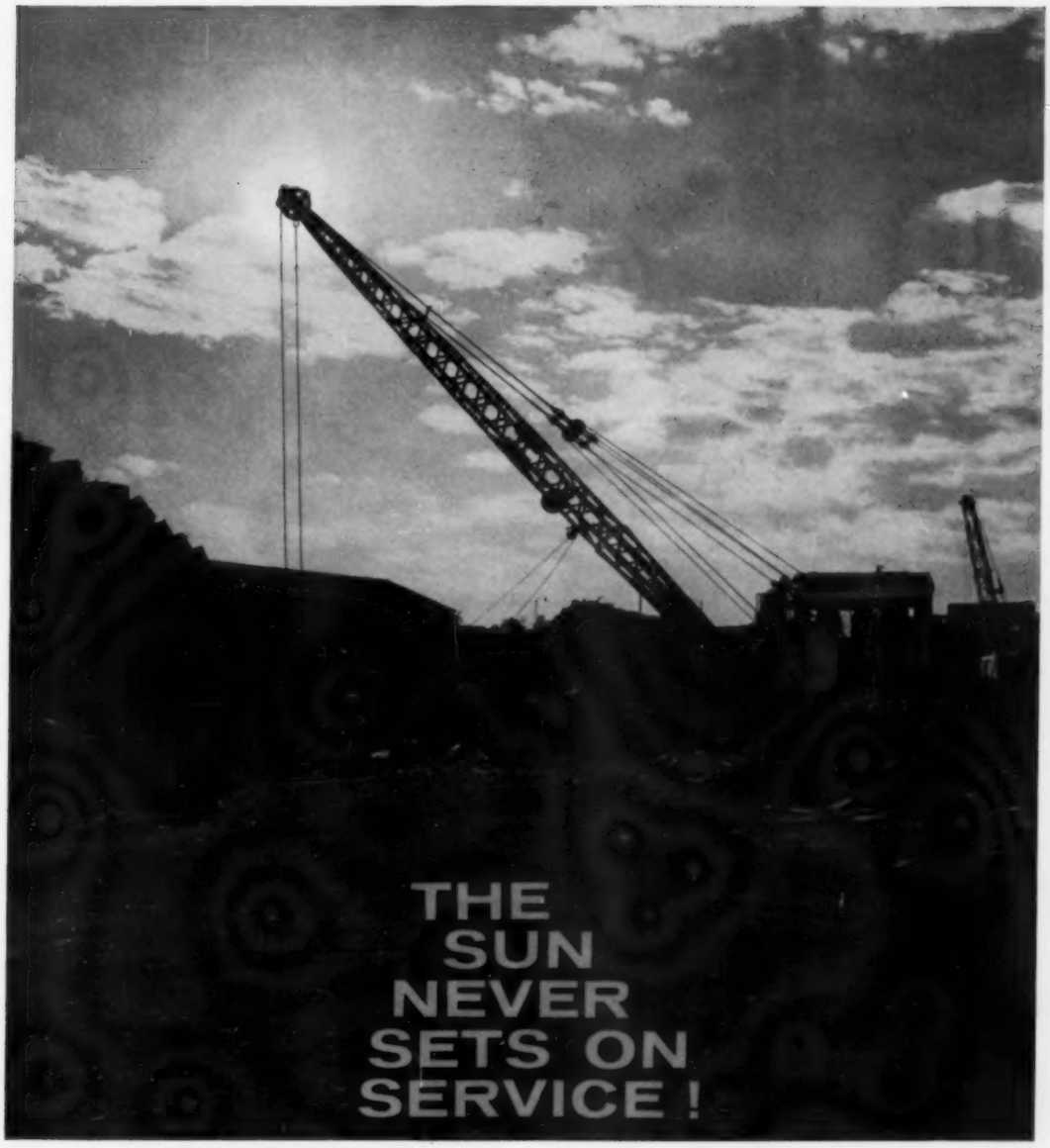

Locomotive cranes slave from dawn to dusk to fill orders on time. And to give good service, scrap steel dealers have to get good service! That's one reason why the H. Klaff Company of Baltimore has relied on Cities Service for more than 13 years.

Another reason is the superior quality of Cities Service products. One breakdown in a crane can bottleneck the entire yard. Klaff's been getting up to 12,000 hours of grueling work out of their cranes . . . without a major overhaul! To lubricate their equipment, they rely on Cities Service C-300 Motor Oil and Trojan Gear Oil for the Diesel cranes, Sentry #1 Oil for baling press bearings, and Trojan H Grease for the hydraulic shear.

H. Klaff gets impressive results from all their equipment . . . and you will, too! You can depend on Cities Service to keep the "go" in your going concern. For information, call your nearest Cities Service office, or write: Cities Service Oil Company, 60 Wall Street, New York 5, New York.

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Works long shifts at slow speeds—Yet no sign of engine deposits after 15,800 hours

MV Two Brothers works long, hard hours at slow, engine-punishing speeds, dragging for fish out of New Bedford, Mass. This 50 ft. fishing boat is powered by a Caterpillar D-13000 engine using RPM DELO Oil exclusively since new. Yet, after 13 years of severe service engine parts remain clean, show surprisingly little wear.

At last major overhaul after 15,800 hours there was no carbon buildup, no sludge or deposits of any kind. Pistons showed no varnish or scuffing, oil ring slots were clean, rings free and clear.

Captain Maurice Clattenburg reports "We are thoroughly satisfied with the performance of RPM DELO Oil. We've gotten outstanding service, and our maintenance records prove it."

RPM DELO OIL reduces wear and prolongs engine life, protects vital parts whether engine is running or idle. Special detergent keeps parts clean, while anti-oxidant fights lacquer and gum formation problems. Other additives cut bearing corrosion and crankcase foaming.

Why not try RPM DELO Oil? Chances are it can cut your costs, lengthen equipment life. Just call your local representative, or write any company listed below:

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PEAKING PLANTS FIND ADDED DUTIES

EMD Engineering Director Describes How Flexibility Of Transportable Diesel-Generator Plants Has Been Increased By New Control Developments

WHEN mobile diesel generating plants were developed in the early 1950s, they were designed and built mainly for utility peaking service. Indeed, the rigid requirements of this service alone required considerable precise engineering to assure adequate and dependable back-up for the purchasing utilities. But as the early plants acquired experience it was found they were well suited for roles other than peaking while still maintaining availability for peaking use.

Original considerations in designing diesel peaking equipment set up seven criteria to be met: mobility, low original cost, quick start capability, reliability, automatic operation, operating ease, and quietness. As the units went into service an eighth criterion was added: flexibility. If the plants were to provide top benefits for purchasers they had to be ready for a variety of services such as decentralized peaking, area backup and spinning reserve.

How these requirements were met by the builders was described recently by B. B. Brownell, director of engineering and research for GM's Electro-Motive Division in an address before the American Power Conference in Chicago. "These criteria called for engineering development, particularly in the area of horsepower output of the prime mover, development of special controls and increased sound control," he told the conference.

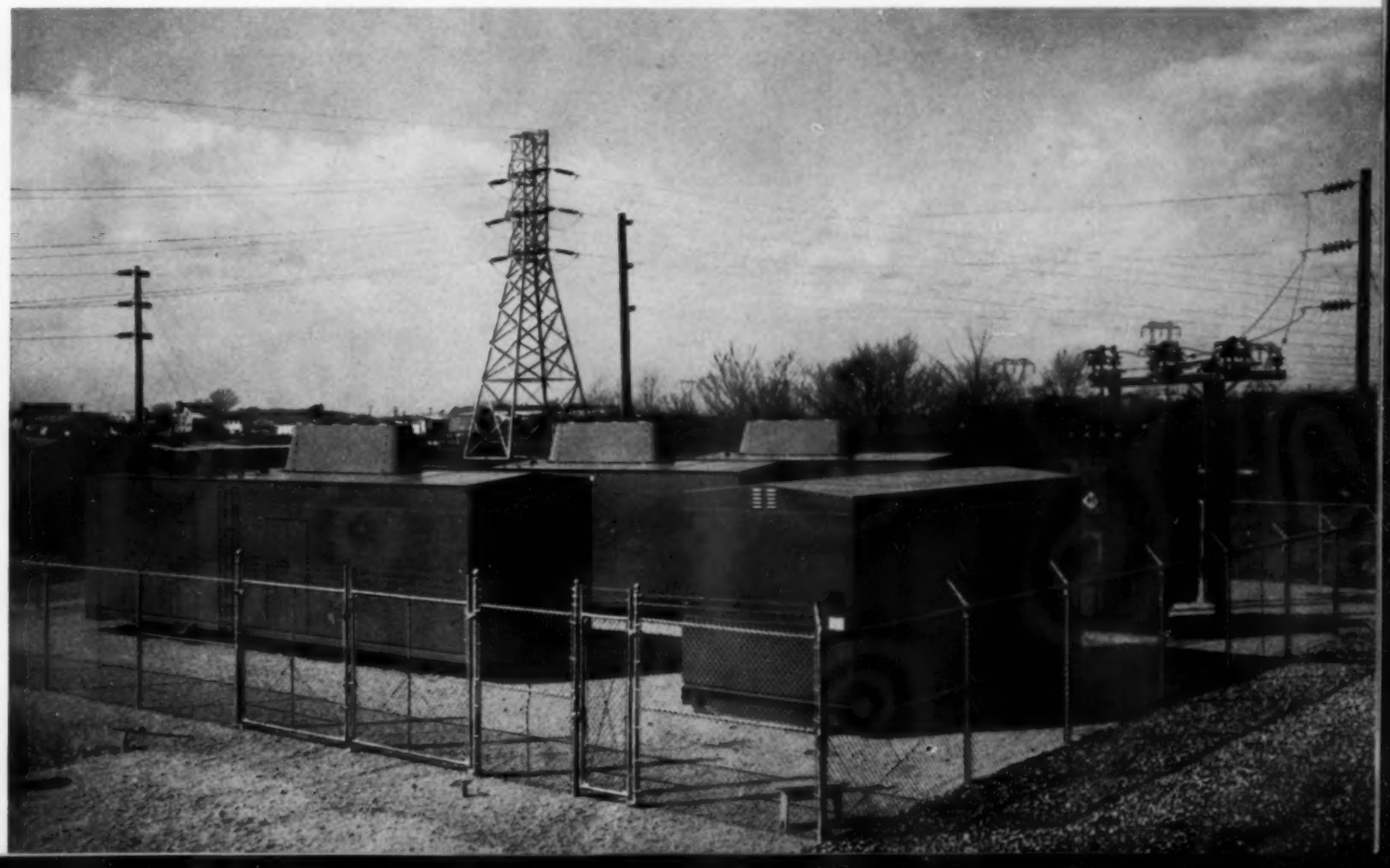
Mobility was a basic feature of the first diesel peaking units built by EMD, a railcar unit of 1000 kw capacity, and a 500 kw unit housed in a highway semi-trailer. The concept of mobility was later supplemented by that of transportability, leading to the present designs in which the plants are supplied with one control unit and up to five engine-generator units which are not on wheels. They can be transported easily by railcar or highway flatbed trailer, permitting greater flexibility in installation as well as transportation.

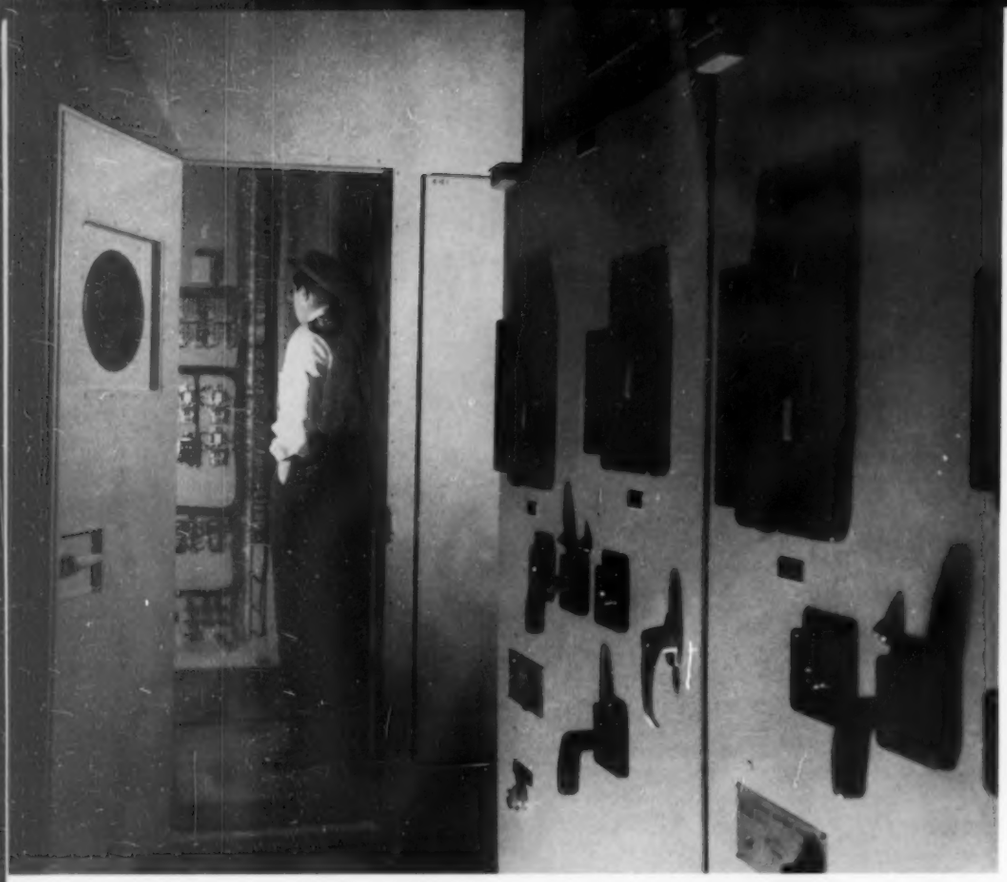
Installed cost of the peaking plants has been pared since 1954 from approx. $175/kw to a 1960 cost of $100/kw. "And 1961 is not yet completed but we expect that before the year is over this will be even lower," Mr. Brownell said. Contributing to the lower installed cost was turbocharging, which, in the case of the D series of GM's 567 engine, permitted an increase to 2000 kw per engine-generator set.

Original criteria called for a fast start and early models featured ability to be on the line with full load in less than two minutes after receiving the starting signal. Since there were no established criteria to define reliability in 1954, a reliability factor of 98 per cent was set by mathematical computation. A 4000 kw, MU42 tested by Philadelphia Electric actually posted an annual reliability record of 99.15 per cent as in 822 individual starts the units failed to come up to speed or start only seven times.

Some of the most impressive advances in the field have been made in providing automatic and unattended operation of multi-unit peaking plants. Simplified controls allow a single control unit to handle a number of engine-generator sets in a number of different operating conditions. Control requirements include handling, by remote control,

Philadelphia Electric Co. 6000 kw, MU60 plant replaced MU42 which was shipped to Brazil. This plant is utilized for peaking service, is now undergoing one year test.





Simplified control units handle a number of engine-generator sets in a multiplicity of operating conditions. Sets can be started and stopped by remote control to handle peaking, 24 varieties of dead load pickup and automatic load sharing, depending on control setup.

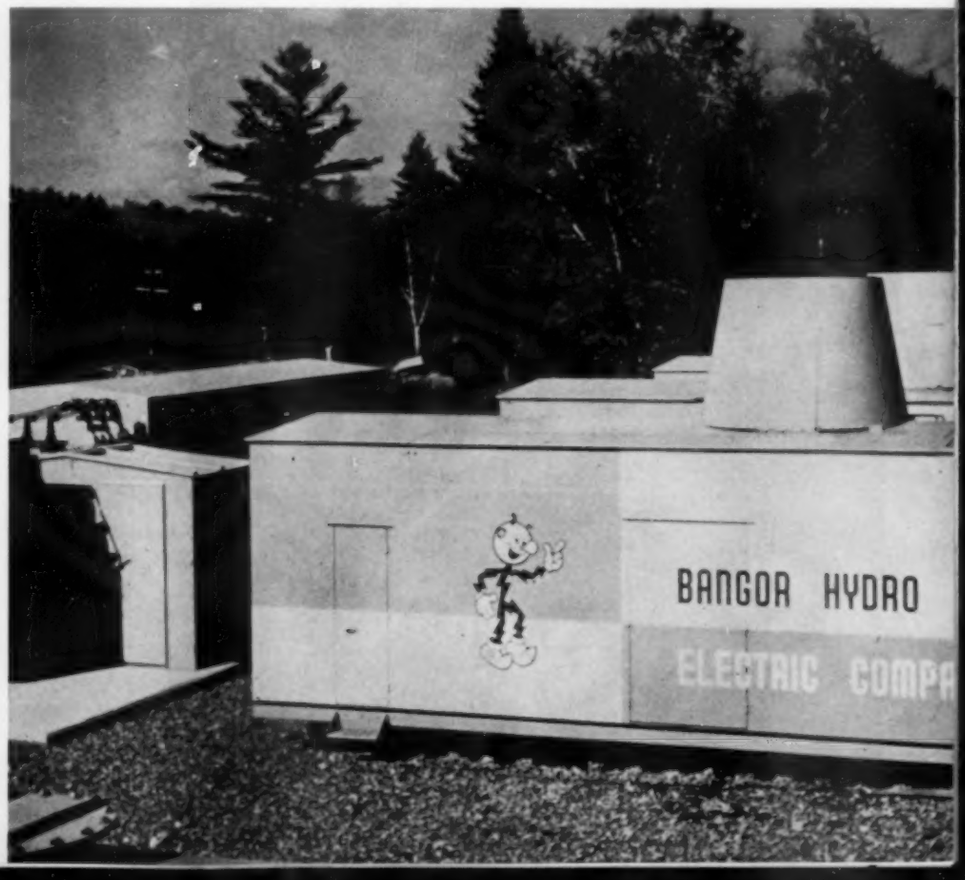
individual unit starts or individualistic sequence control; 24 varieties of dead load pickup; and automatic sharing. "Controls have been developed that automatically bring units on the line either singly or in multiple to handle dead loads within the plant's capability," said Mr. Brownell. "These units can be provided with maximum deadload capability, which, unlike utility generators, enables them to pick up practically any load they can carry. For example, a two megawatt unit can pick up a dead load which has a steady state requirement of 2 mw and an inrush of five times rated kva of the plant."

Refinements have resulted in a design which placed controls in a separate control unit. This took vital relays, contactors, and other switchgear out of the engine-generator box and away from heat, vibration and other elements that could affect their operation. Reduction of noise levels of the machines plus studied placement of the units have played an important role in reducing overall sound levels. Early studies indicated an estimated maintenance cost of $2.47/kw/yr. But with the various improvements in engines, components and switchgear the maintenance figure was down to $1.90/kw/yr. in 1959 and further improvements have been such that EMD now offers service contracts based on a figure of $1/kw/yr.

Flexibility, the eighth and newest criterion for these plants, has advanced to the point where, equipped with dead load pickup and automatic load sharing controls, these units can handle such assignments as area backup and spinning reserve in addition to peaking. They can also be used as cranking plants for base load steam plants. Through the multi-unit-concept, control units purchased originally to control one or two engine-generator sets can later be equipped to handle as many as five 2000 kw engine-generator units.

The plants can be equipped to operate as either straight diesel fuel units or for dual fuel operation. The sets can be designed to furnish either 50 cycle or 60 cycle current. And, because of the "building block" design, they can be arranged to fit the site or terrain—in a square, in a line, or in any convenient arrangement. They require only a crushed rock or cinder and railroad ties or concrete slabs for foundation. Let's look briefly at some of the installations using EMD's mobile plants and see how utilities have fitted them to their own operations.

Public Service Co., of Oklahoma has installed a 2000 kw, MU20 plant at the end of a 34.5 kv line near Grandfield, Okla. This one-unit plant is utilized for peaking and to protect against service outages in the town. When a fault occurs, the breaker at Grandfield is tripped by loss-of-potential relays which supply the starting signals to the MU20 and trip a breaker that disconnects a capacitor bank from the substation bus. When the plant comes up to speed its breakers close automatically and a breaker on the 2.4 kv distribution feeder is opened for 10 seconds, then recloses. This limits deadload requirements to the load of a nearby refinery and TV station. When the 34.5 kv line has been restored to service for 15 minutes, the diesel unit automatically synchronizes into the line, continues to operate for another three minutes, then automatically shuts down unless the peaking signal is in effect.



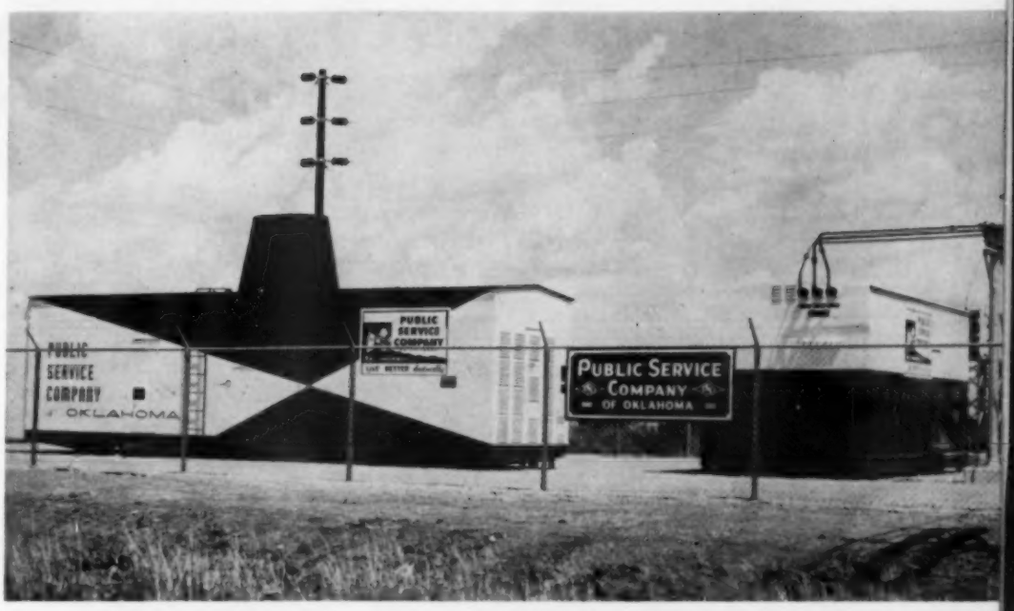
Bangor Hydro Electric Co. 8000 kw, MU80 decentralized peaking plant shaves peaks, provides area protection in outages. Remotely controlled plant is equipped for automatic dead load pickup and load sharing.

Another unit, installed by Interstate Power Co., at Hills, Minn., is used principally as a peaker. But it can also provide uninterrupted power service to the Hills area through its dead load pickup. Purchased to improve electric service in the area, the unit was installed in place of a more costly second transmission line. Edison Sault Electric Co., has a similar unit at Manistique, Mich.

A dual fuel version of the MU equipment series is installed at Ames, Iowa, for the Iowa Electric Light and Power Co. Rated 2000 kw, the plant operates on either diesel fuel or natural gas. It is remotely controlled to protect a U.S. government animal disease laboratory and is equipped for dead load pickup, starting when one line to the laboratory goes out and going on the line when a second line fails. (This plant was fully described in the April, 1961 issue of DIESEL AND GAS ENGINE PROGRESS.)

As mentioned above, Philadelphia Electric Co., established reliability of their peaking plant by a series of 822 starts in a one year test period. All starts were made by remote control with time varying from 46 to 82 seconds from starting impulse to full load. The original MU42 was resold to the Brazilian government in 1960 to provide power for that country's new capital, Brazilia, and Philadelphia Electric has purchased a 6000 kw, MU60 plant to replace it. The Brazilian purchase illustrated the plant's transportability: the MU42 was on the dock, awaiting shipment to Brazil, seven days after receipt of the order.

Another unique installation is at Newport, R.I., on the Newport Electric Corp., system. This 4000 kw, MU40 plant was rushed to completion to meet winter peaks. Five weeks later a cold snap placed peak loads of up to 10 hours per day on the plant. Newport Electric purchased the MU40 with MU80 switchgear so the plant could be converted quickly as power generation requirements rose and two more generator units will soon be added to the original plant.

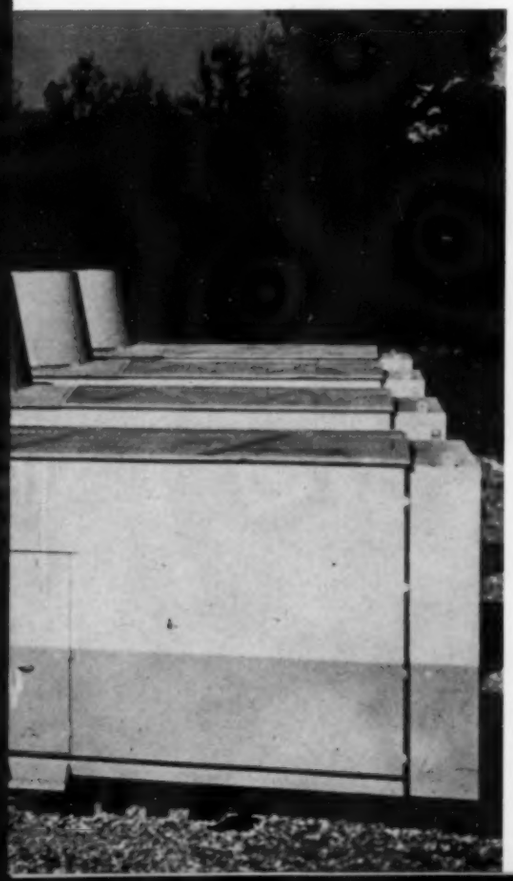


Automatic dead load pickup controls on this Public Service Co., of Oklahoma plant provide area protection for refinery, TV station near Grandfield. The 2000 kw unit is also used as a peaker.

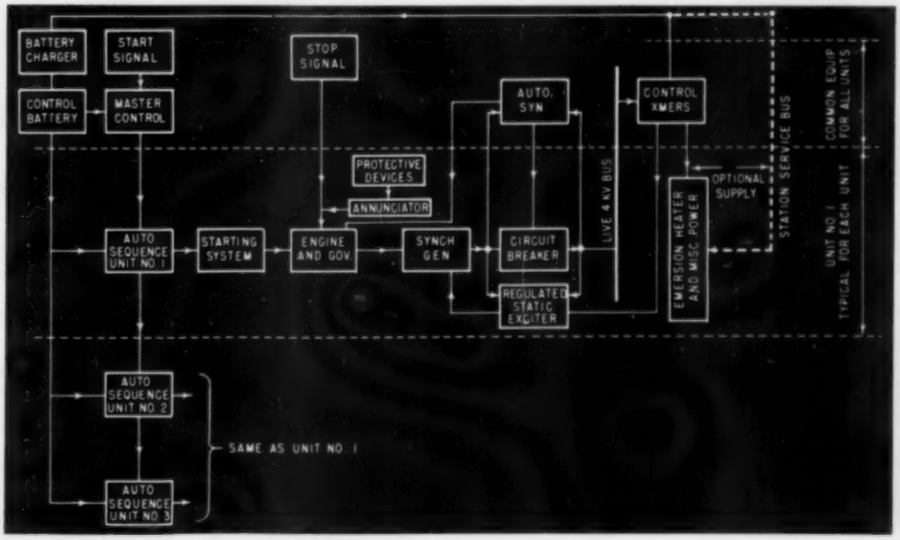
Another peaking and outage plant is owned by Bangor Hydro Electric Co., and installed at Medway, Me. The 8000 kw, MU80 plant is tied in at the run of river hydro plant, is used for peaking and as automatic area protection, and is equipped with automatic load pickup and load sharing controls. In case of a line outage, the plant, started remotely, will pick up the load and ride up and down with it, sharing the load between generators until service is restored. Bangor Electric has also ordered another MU80 plant for installation at the southern end of its system.

Another use for a diesel peaking plant has been found in an MU80 plant scheduled for delivery later this year to Atlantic City Electric Co. This plant will serve as a cranking unit for a steam plant in addition to service in peaking. Three MU60 plants (two at Reno and one at Carson City) went into service in 1960 for the Sierra Pacific Electric Co. They are operated in pure peaking service. The company has ordered an MU80 for delivery this summer. This one will be equipped with automatic controls for deadload pickup to provide area protection in addition to peaking service.

"Each new application provides another challenge to engineer more functional flexibility into standard units," Mr. Brownell concluded. "We look forward to a particularly bright future for this type of equipment on tomorrow's utility system."



Block diagram of automatic control system.



MULTIPLE CONTROLS AND DRIVES ON EXETER RIG NO. 3

EXETER Drilling Co., Rig No. 3 has been converted to diesel-electric drive by Continental-Emsco using Caterpillar main engines and a General Electric V-222 rig drive system. The medium-depth rig's first assignment was for the Delphi-Taylor Corp., near Farmington, N. M.

The all-electric rig was one of the first applications of a Caterpillar D353C turbocharged diesel engine powering G-E model GT602 drilling generators. The rig features extreme portability—engines, generators and control equipment are on one 20 ton skid which is 8x29 ft.—plus some novel operating features. With its two diesel engines, the rig can deliver up to 700 hp to the mud pumps while drilling. All equipment on the power skid is permanently wired. During a move it is only necessary to unplug three cables each to the drawworks and pump motors, two to the driller's console, two air throttle lines and cables to the auxiliary ac motors and lights.

In addition to the two Cat D353C main engines, the rig utilizes a Caterpillar D333A engine-generator set and a Waukesha 135 DK engine which drives the mud mix pump.

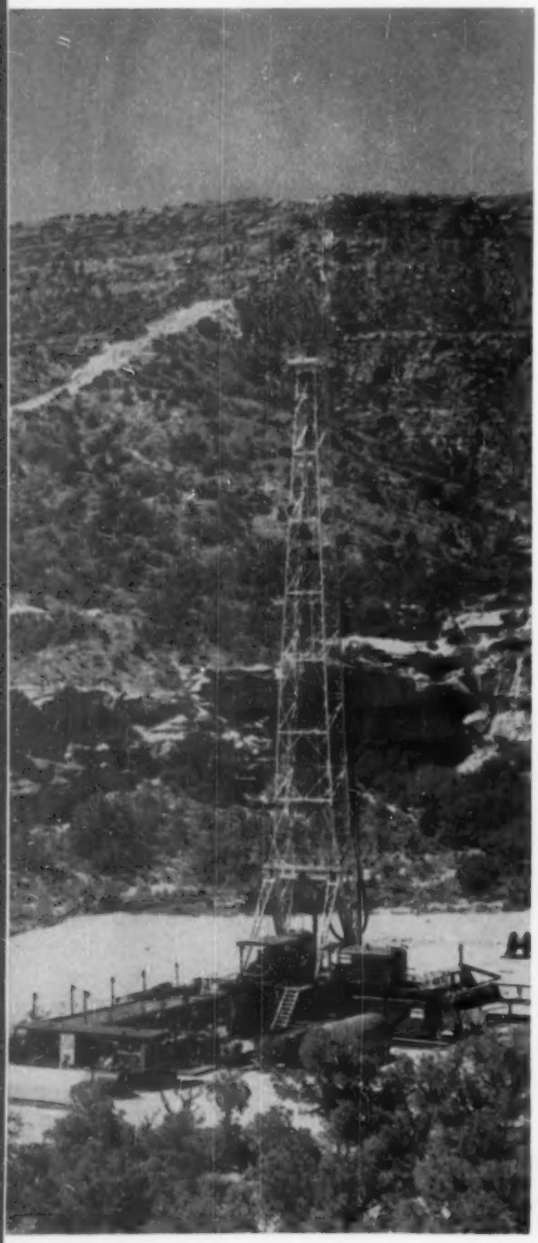
A National drawworks is chain driven by a G-E 752UI double shaft extension drilling motor, which also drives one of the air compressors. The 17½ in. rotary table is chain driven from the drawworks. The mast is a 127 ft. Lee C. Moore and the substructure is 11 ft. high. The Continental-Emsco main mud pump is also driven by a G-E 752UI motor utilized on the back of the pump skid with chain drive.

The D353C main engines are rated 425 hp at 1400 rpm for this particular installation. These 6-cylinder, 6¼ in. bore and 8 in. stroke units are turbocharged and aftercooled and are equipped with blower fans. One engine has a gasoline starter, the other an air starter. Each engine drives a G-E GT-602AI single bearing, self-ventilated flywheel mounted drilling generator rated 450 hp at 1400 rpm and 650 hp at 2100 rpm.

The D333A diesel driving the light plant and auxiliary power generator drives a 50 kw, 1800 rpm, G-E brushless ac generator and a 25 kw, dc exciter. A standby duplicate generator and exciter are belted from the tail shaft of the No. 2 main drilling generator.

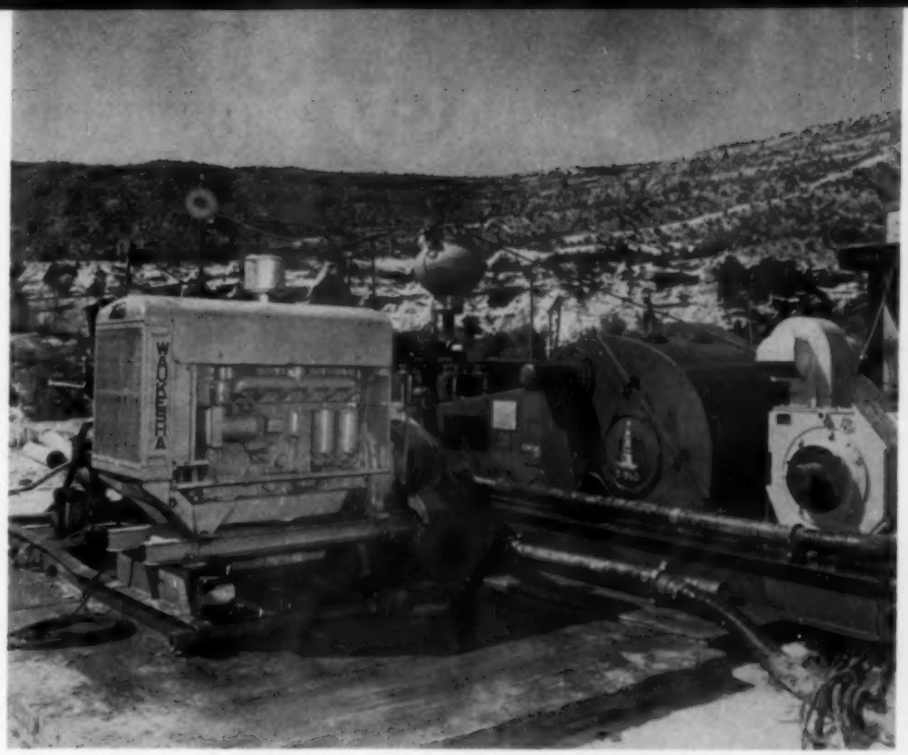
Also on the main power skid is the main electric control compartment containing all ac and dc controls for the rig and a motor driven air compressor and tank.

The power system is arranged so the driller may assign either generator to either motor or both motors via two generator assignment switches on his console. In hoisting assignments (figures a, b



Exeter Drilling Co., Rig No. 3 on location east of Farmington, N. M. for Delhi-Taylor Oil Corp.

Main power skid is 8x29 ft., weighs 40,000 lbs. At far right are two main Caterpillar D353C diesel engines, each driving a flywheel-mounted General Electric GT-602A1 drilling generator. Standby 25 kw dc exciter and 50 kw generator are belt driven from tail shaft of No. 2 drilling generator. At right is Cat D333A auxiliary engine driving 50 kw generator for lighting, auxiliary power. Main control cabinet between the engines contains all ac and dc controls.



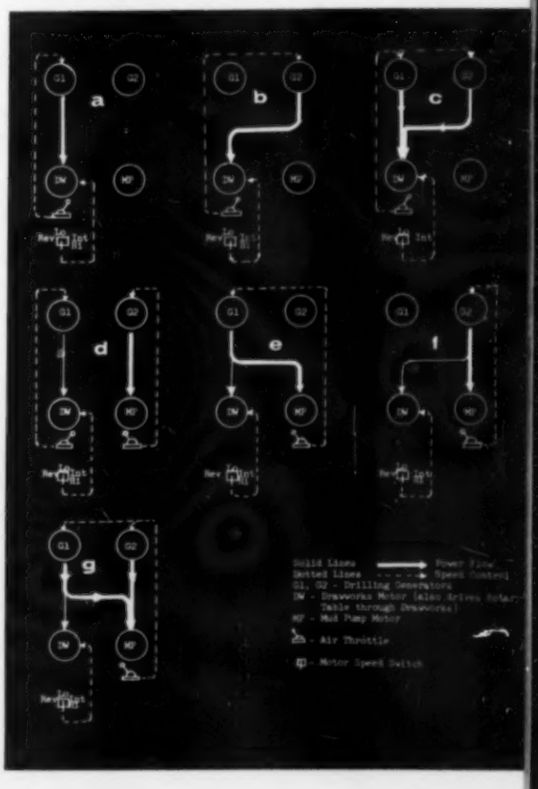
Waukesha 135 DK diesel engine drives Gardner-Denver mud pumps via clutch power takeoff and V belts. Main mud pump is driven by GE 752U1 drilling motor rated 700 hp input for pumping service.

and c in diagram) the air throttle controls output of the assigned generator or of both generators in parallel to infinitely control motor speed from creeping to top speed. Top motor speed at full throttle can further be preset by the drawworks motor speed switch. This amounts to an electrical gear shift in the motor with one reverse and three forward speeds, the high setting being about 50 per cent faster than low in this application.

While drilling, one generator is assigned to each motor, providing independent stepless throttle control of pump and rotary speed (d) or either engine can be used to power the pump and rotary (diagrams e and f). In the latter case, the pump throttle governs generator output which affects the speed of both motors. This throttle is set to give desired pump operation. Then rotary speed can be independently adjusted by the choice of drawworks transmission ratios and the setting of the rotary (drawworks) speed switch. The 50A drawworks has three transmission ratios which change rotary speed and for each mechanical ratio three electrical speed ranges are available. If power available from one engine-generator set is insufficient for pump requirements then both generators can be compounded on both motors (diagram g) and the pump and rotary motors would then absorb power in proportion to their respective loads, with most of the power of the two engines going to the pump and a relatively small part to the rotary.

The control system provides the option of operating the main drilling engines at constant speed or variable speed. When the engine speed control switch is set on constant speed, full pressure is applied to the air actuated governor keeping the engines at top governed speed of about 1400 rpm. The driller's throttles are then connected only to actuators which control generator excitation. Thus the driller controls generator voltage end electric motor speeds without changing engine speed. When the engine speed switch is at variable, the air throttles are connected directly to the engine governor actuators and to the generator control actuators. Advancing the throttle changes the engine governor setting to accelerate the engines from low idle (about 650 rpm with throttle off) to full speed in proportion to throttle position. At the same time generator excitation is increased and the excitation and speed changes on the generator changes its voltage output to control electric motor speed. Variable speed operation permits the engines to idle at low speed when throttles are off and at intermediate speed when partially advanced, indicating less than full power requirements. This engine speed control system permits the main engines to operate at variable speed which conserves fuel during light or partial load periods while drilling but requires that auxiliary power be supplied from the separate D333A engine-generator plant.

A number of safety features are incorporated in the system. The small driller's console is designed to be slightly pressurized by an air hose connection to insure leakage outward of combustible gases. Main power circuits are grounded through a relay which removes all power in event of an electrical fault to ground to prevent arcing and signals the driller by a light on the console. Since the driller's console is located on the rig floor, an emergency switch is provided in the control compartment on the engine skid to perform essential power assignment functions in event of damage to the console or its two connecting cables. Cutout switches prevent starting a motor while its connected machine is being worked on, or from loading a generator while an engine is being adjusted. In addition the circuitry of each generator is interlocked through a switch on its engine to isolate the generator in event of low oil pressure or high water temperature. A push button on the console can remove all power in case of an emergency. All throttles must be returned to off position to restart.



Sketch shows power assignments available to driller. Assignments are explained in text.

DIESELS, UNIQUE PM SETUP REDUCE CARRIER'S COSTS

By ANTHONY A. ALBERTE

IN the maintenance garage of Express Freight Lines at Milwaukee is a room completely equipped for diesel injector servicing. Preventive maintenance is a continuing part of Express' efforts to supply efficient customer service. So it was natural the company officials should anticipate their service needs and provide the equipment to keep their newly-purchased diesels in top shape. The room was built about two years ago, when the first of 32 diesels were purchased. Now here's the twist—the room has never been used because thus far there just hasn't been enough injector trouble to warrant its use, even though the fleet rolls up nearly 290,000 miles a month. The few service requirements have been handled by outside shops since, costwise, the few troubles encountered made in-shop handling uneconomical. "And we haven't had major trouble with any other facet of the engines either," explained Harold Rabidoux, Express Freight's maintenance superintendent.

Express Freight Lines is a common carrier offering direct, overnight service between Milwaukee and Detroit, and points between. One unusual feature of Express' route is the fact that although the firm's line skirts the southern tip of Lake Michigan, Express does not haul into Chicago. Thus Express Freight units leave Milwaukee on Hy 41 and Interstate 94, skirt Chicago on the Tri-State Tollway and reach Detroit over U.S. 112 and Michigan 60.

Express Freight lines was founded in 1933 operating one leased tractor-trailer between Milwaukee, South Bend and Detroit. Today the company has a large modern fleet of company-owned tractors, trailers and trucks. Terminals are at Detroit, South Bend, Racine-Kenosha and Milwaukee. Each night loads move between these terminals and are delivered at the destinations the following morning. The Detroit-Milwaukee run is about 400 mi. and almost every type of dry freight is handled between these industrial communities.

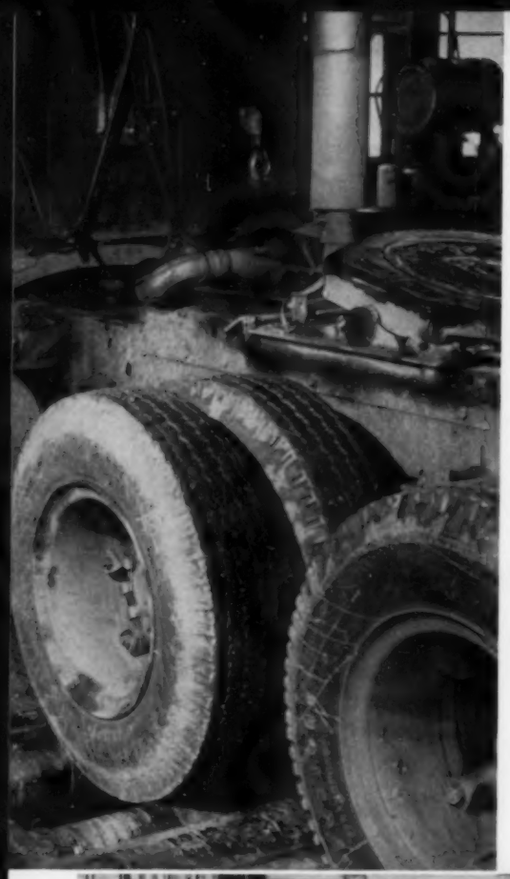
Express Freight acquired their first diesel tractors in 1959. The initial order was for 10 GMC model 860 conventional tractors equipped with GMC 6-71E engines. Another 10 tractors of similar make were added later in 1959. Then in early 1960 Express bought 12 new International-Harvester Emeryville West Coasters—I-H's DCO-405 tractor, also equipped with GM 6-71E engines. The 6-71E is a six cylinder, two stroke diesel rated 217 bhp at 2100 rpm. The engine has bore and stroke of 4¼ x 5 in., total displacement of 425.6 cu. in., and 17:1 compression ratio. All the tractors have Fuller 10 speed RoadRanger transmissions and Eaton 1911 single speed axles. The GMCs have Lipe-Rollway clutches, the I-H models have Spicers. Both are 14 in. two plate types. The units are licensed at 58,000 lbs. gcw on single axle models and 68,000 lbs. gcw on the tandems. Payloads average 35,000 lbs. on single axle and 40,000 lbs. on the tandem models. The company fleet now includes 68 units, including the 32 diesels. To assure correct loading and also to insure that the loads do not exceed legal requirements, Express policy requires that all loads be weighed at the terminal before dispatch.

With the diesel tractors, drivers make the trip to Detroit in 8½ hrs. driving time. Because the diesel engine provides power characteristics that allow higher average speeds, the tractors can make the run in one regular shift. Gasoline-powered tractors, said Rabidoux, can make the trip in the same time but "the driver would be pressing more to keep the schedule." Actually, the diesels cut driving time about 60-90 minutes over similar gasoline-powered units.

Maintenance of Express Freight's fleet is carried out by a subsidiary E.F.L. Motors, Inc. This allows the firm to record maintenance costs on the basis of regular "shop cost," giving a figure more comparable to maintenance costs in the field. Maintenance is carried out at the Milwaukee terminal, which also houses main offices of the firm. This shop design had an unusual background. When Express decided to build new office and shop facilities, workers were asked to "design" their work space to fit their jobs. Each drew a sketch of their "ideal working space." Then these ideas were incorporated into final design of the building wherever practicable.

Maintenance scheduling is recorded by means of a Produc-trol board on which every unit requiring service is represented by a marker attached to a string. Maintenance operations are represented by pegs inserted in the board. As a unit acquires mileage, the string marker moves across the board to the mileage represented by a given position.

Several of Express Freight's diesel tractors at the Milwaukee terminal loading dock. GMC's are model 860, Internationals are model DCO-405. All 32 of the line's diesel tractors have 6-71 diesel engines.



fuel and lube oil filters are changed. Also at this time a horsepower check on the Clayton chassis dynamometer is carried out. The service at every 30,000 mi. includes engine tuneup, check of fuel tanks, generator and starter and clutch control. This 30,000 mi. check was originally scheduled every 15,000 mi. but it was found after early periods that the service interval could be extended safely. The 50,000 check includes servicing of wheel bearings and brakes.

All the Express diesels are equipped with Winslow fuel and lube oil filters and all use Perry water filters. Fuel oil and lube oil is Mobil (Socony). Lube oil is stored in bulk tanks piped to the service bays. "Not much of a time saver when the shop is not busy but when they're loaded with shop rates figuring labor costs near commercial shop "book" rates per hour.

Every 6000 mi., diesel tractors are checked on this Clayton chassis dynamometer. Officials report no horsepower loss on the units though some are above 220,000 mi. mark.

Underhood view of International Emeryville West Coaster with GM 6-71E diesel. Engine is rated 217 bhp at 2100 rpm. Units are equipped with Fuller RoadRanger transmission, Eaton axles.

Express Freight maintenance subsidiary is housed at main office and terminal. When the building was planned mechanics were given opportunity to suggest shop layout, lighting.

Here are the cumulative figures for the 32 unit diesel fleet. These include data since the first GMC was added:

Accumulated miles—5,014,792
Accumulated cost per mi.—2.4 cents
Accumulated miles per gal.—6.2
Accumulated cost per mi.—.0612 cents*
*Fuel and maintenance only.

Resulting economy and efficiency have satisfied Express Freight Lines that its long-range equipment program should contemplate diesel tractors as replacements.

President of Express Freight is A. A. Zebrowski; vice-president is C. J. Moore. Secretary and operations manager is J. R. Zebrowski and K. W. Berger is comptroller and treasurer.

Produc-trol board is visual maintenance schedule. Strings represent tractors, pegs are maintenance check operations. When string meets peg, representing mileage interval, maintenance operation is carried out.

When the marker reaches a peg representing a maintenance operation, that operation is carried out and the peg moved ahead. Then the labor, material and other costs of the operation are recorded on a card index at the side of the board. This card is used for figuring monthly costs and is then transcribed to a permanent record.

Diesel preventive maintenance operations are carried out at 3,000, 6,000, 30,000 and 50,000 mi. intervals. The check made every 3,000 mi. includes lubrication, air cleaner service and a check of safety equipment. At 6,000 mi. lube oil, and water, jobs even the few minutes that this feature saves is valuable," said the maintenance chief.

In a typical month, Express Freight's diesel tractors turn in an average of about 290,000 mi. Although the mileage was down slightly from the average, Rabidoux's figures for March, 1961 are interesting:

Number of diesels—32
Line haul miles—278,750
Miles per gallon fuel—5.5
Maintenance and repair costs—2.9 cents/mi*
*Maintenance and repair costs are based on

MANSFIELD, OHIO'S NEW SEWAGE TREATMENT PLANT

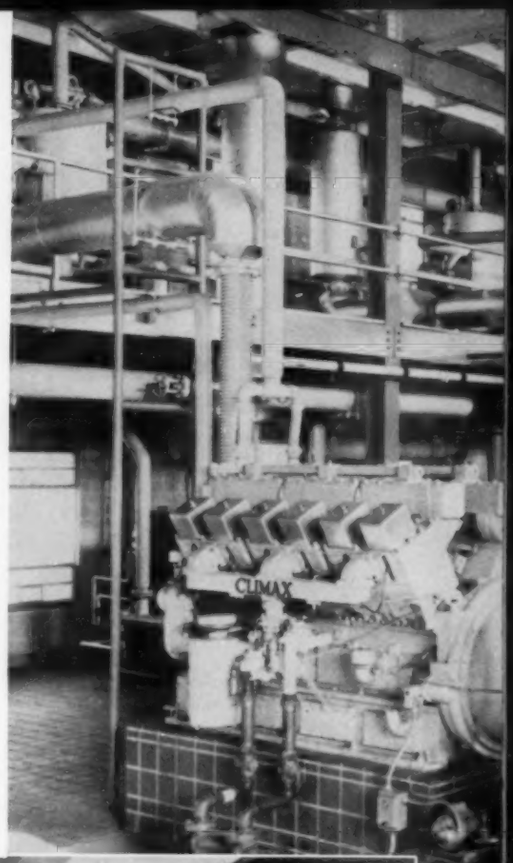
By LAWRENCE E. RIGBY*

THE City of Mansfield is ideally located in the North Central section of Ohio. Its present population of 50,000 people grew rapidly from its initial start as a City of 3500 in 1857. The City through its transportation facilities, which includes five major highways and three railroads, has diversification in industry, commerce, and agriculture. Such industries as the steel mill, steel fabricators, plumbing fixtures, appliance manufactures, pump manufactures, rubber, electrical, and metal plating industries are a few of the larger industries located in or around Mansfield.

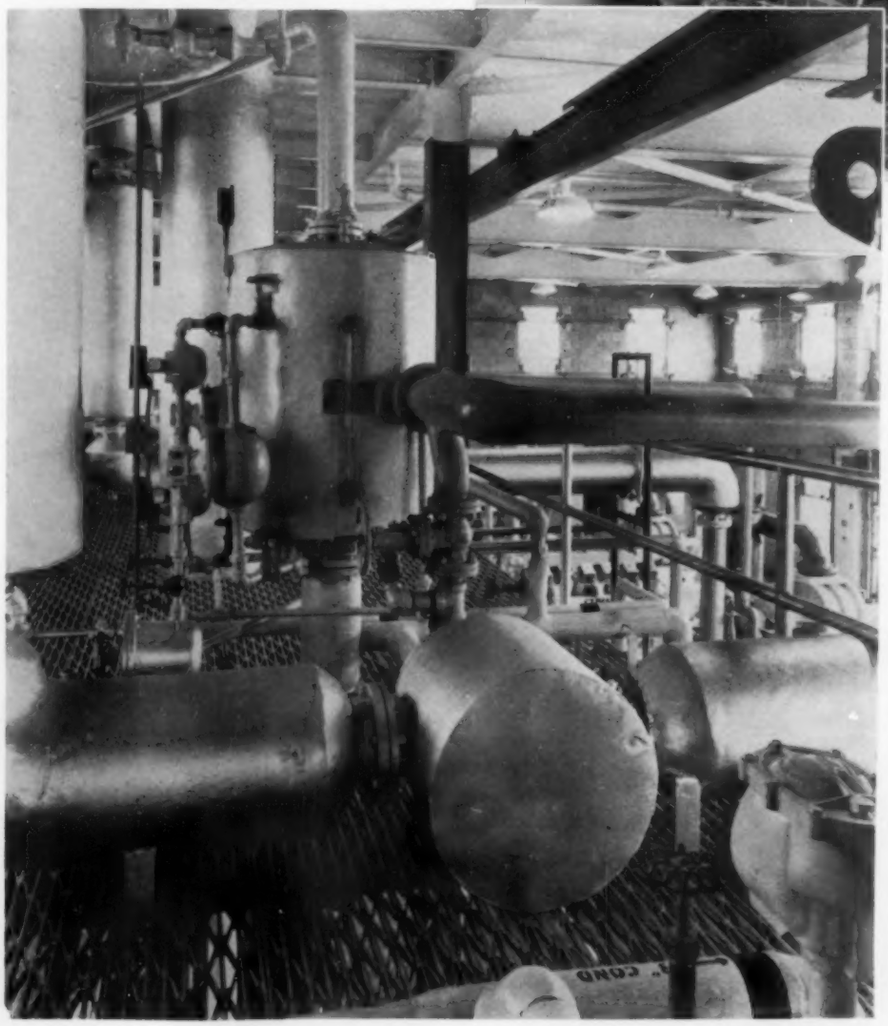
Mansfield as early as 1902 had one of the first sewage treatment plants in the state. Through the years the City kept abreast of the pollution, replacing the original plant in 1936. Since then the City has grown and expanded rapidly.

Seeing problems ahead, city officials hired Floyd G. Browne & Associates of Marion, Ohio to investigate and make the necessary recommendations. They recommended additional sewers to serve a future population of 250,000 and industry in the surrounding area, with a sewage treatment plant of the activated sludge type for 110,000 population equivalent. The total project cost $8.6 million. The $4.6 million worth of sewers and the $4 million sewage treatment plant was completed and put into operation with the formal dedication of the new sewage treatment plant in October, 1960. The sewage treatment plant was designed for a future population of 80,000 (population equivalent of 110,000) with an average design flow of 15.0 mgd and a maximum flow of 25 mgd. The plant was built on a 26 acre tract of land and laid out for easy expansion to double its present size. The plant incorporates the latest method of sewage treatment practices such as step aeration, reaeration, thickening of raw and waste activated sludge, high rate digestion, vacuum filtration of digested sludge, and utilization of sewage gas.

Sewage gas from the primary digesters is collected and stored in a gas holder cover, 30,000 cu. ft. capacity, for use in the gas engines in the blower building. The sewage gas, consisting of about 70 per cent methane and about 25 per cent carbon dioxide, has a Btu value of about 600. The gas is stored in the gas holder at 8 in. water pressure (5.7 oz.); gas booster pumps pump the gas into a 12 in. cast iron pipe storage main to the blower building. Pressure is reduced at the engines to the

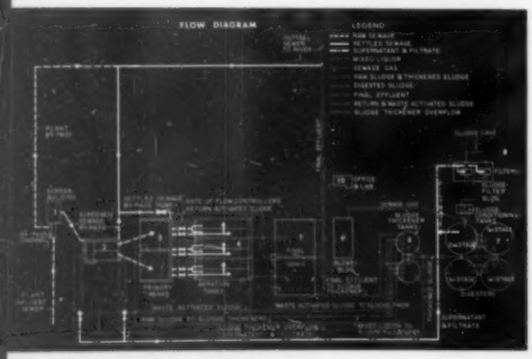


Four 215 bhp Climax V-125 gas engines drive Roots-Connersville blowers at the Mansfield sewage plant. Engines operate on 600 Btu sewage gas or gas fuel blend. Each is equipped with four Ensign carburetors, American Bosch magnetos. Engines and blowers are connected through Twin Disc clutches, Falk couplings. On the mezzanine are the Vapor Phase boilers and separators.

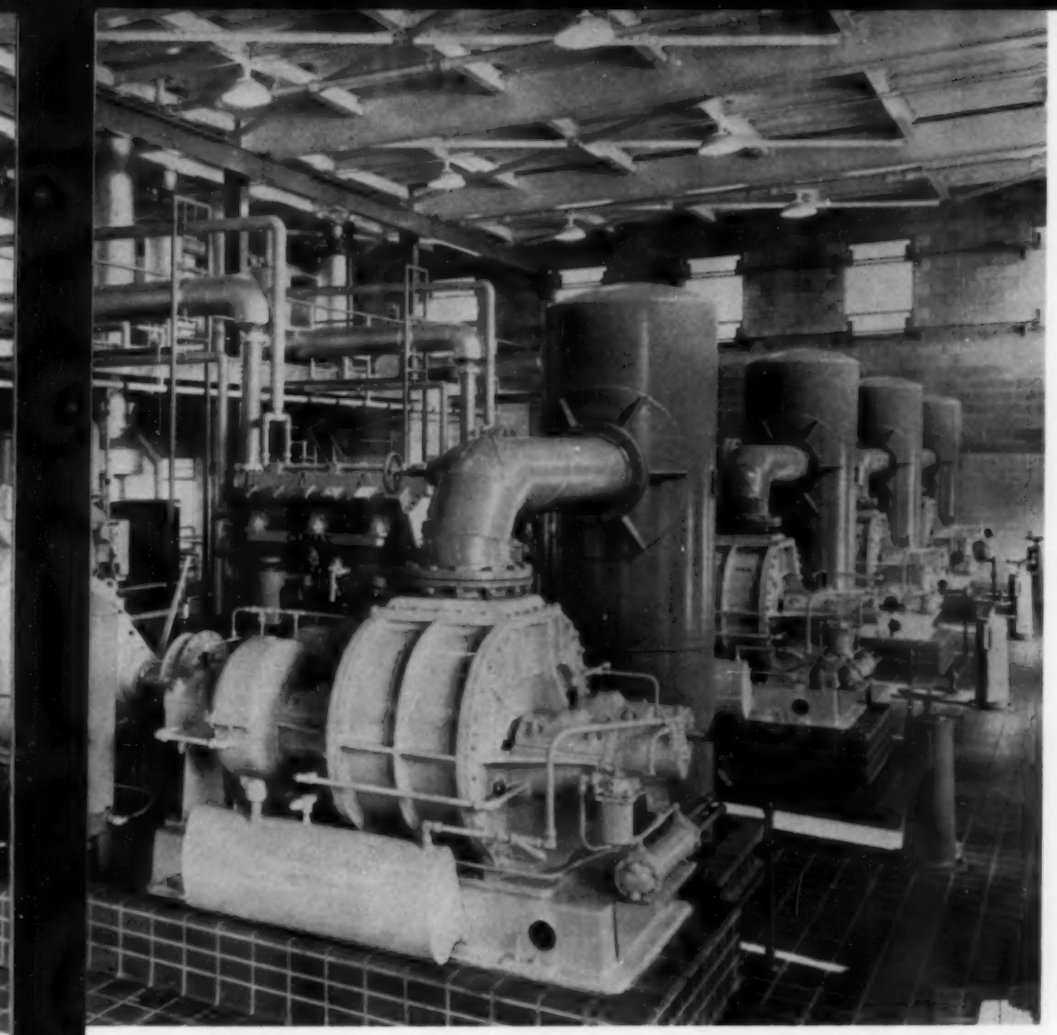


One of four Vapor Phase exhaust recover boilers and steam separators. Ebullient cooling keeps engine temperatures at 240-250° with waste heat recovered for plant, digester heating.

Flow diagram of Mansfield plant.



*Asst. City Engineer, Mansfield, Ohio.



necessary seven ounces for proper feed to the carburetors. Natural gas is used as the auxiliary fuel when the plant does not produce enough sewage gas. Natural gas pressure is held at 6 oz. If sewage gas pressure falls below 7 oz., natural gas will automatically blend with the sewage gas. The four Climax V-125 gas engines driving the blowers are 12 cylinder, four cycle, V-type engines rated at 215 bhp at 650 rpm. The engines have a 7½ x 7 in. bore and stroke with a piston displacement of 3700 cu. in. They drive four Roots-Connersville positive displacement blowers rated at 5200 cfm at 7.5 psig. through Twin Disc friction clutches and Falk Airflex couplings. The intake air does not require filtering before the blowers due to the type of diffused air equipment in use at the plant.

The engines are equipped with four carburetors, two for sewage gas and two for natural gas, a pair to feed each bank of cylinders. There are two spark plugs per cylinder and each engine has four high-tension American Bosch magnetos. Other auxiliary equipment is an air motor starting system, oil filter, cooling water exchanger and pump, thermostatic controls on cooling water, intake air filters, and centrifugal governors. In case of low water the engines will automatically shut down. High water in the system will not harm the operation of the engine.

The Vapor Phase ebullient cooling system is used on the engines. Since Vapor Phase can operate at 240° to 250°, the engine is cooled with steam and in the process makes more steam to be used for building heat and heating the digesters. By "cooling" with steam the engines can operate at a higher temperature which results in a more efficient engine and cleaner combustion, jacket water temperature differential is lower which reduces stresses and wear, and less water is formed by condensation, reducing the amount of acids and other contaminants. A waste heat recovery boiler is installed in the engine exhaust line to utilize the remaining heat in the exhaust gases to assist in making steam. During the warmer summer months, when less heat is required, the excess steam is wasted to turbine condensors and the condensate returned to the system. During the heating season when additional heat is required above that produced by the engines, two 336,000 Btu per hour output copper water tube boilers are used. The boilers automatically cut on if the steam pressure falls below 7 psig.

The Climax engines are operated continuously at constant speed for 1000 hrs. before taken out of service for periodic maintenance check. At this time the heads are torqued, tappets and clearances are checked, plugs cleaned and adjusted, and the ignition timing is checked.

Oil consumption has been consistent on all engines at about 1½ gals. per day. Approximate fuel consumption at 600 rpm has been 3000 cu. ft. per hr. of sewage gas and 1800 cu. ft. per hr. for natural gas. Present gas production at the plant is approximately 75,000 cu. ft. per day, sufficient for continuous operation of one engine. Use of sewage gas results in a savings of approximately $1,000 per month. Each engine at this time has approximately 3000 hrs. running time. Experience so far has been satisfactory—no repairs and only periodic maintenance checks and new plugs.

There are twelve men employed at the sewage treatment plant. Plant personnel include chief operator, laboratory assistant, two maintenance men, operating personnel and laborers. City officials largely responsible for the completion of the construction program were Mayor Robert S. Lemley, Service Director J. J. Schwab, and members of council. Contracts for the construction of the sewage plant were signed in January 1958.

Principal Equipment

Engines	Climax
Ebullient cooling	Engineering Controls
Couplings	Falk
Clutches	Twin Disc
High tension ignition systems	American Bosch
Carburetors	Ensign
Engine Controls	Penn, Honeywell
Starting motors	Ingersoll-Rand
Intake air filters	Vortox
Lube oil filters	Honan-Crane

Aerial view of Mansfield, Ohio sewage treatment plant which has a maximum design flow of 25 mgd.

POWERFUL BOAT FOR COAL TRADE

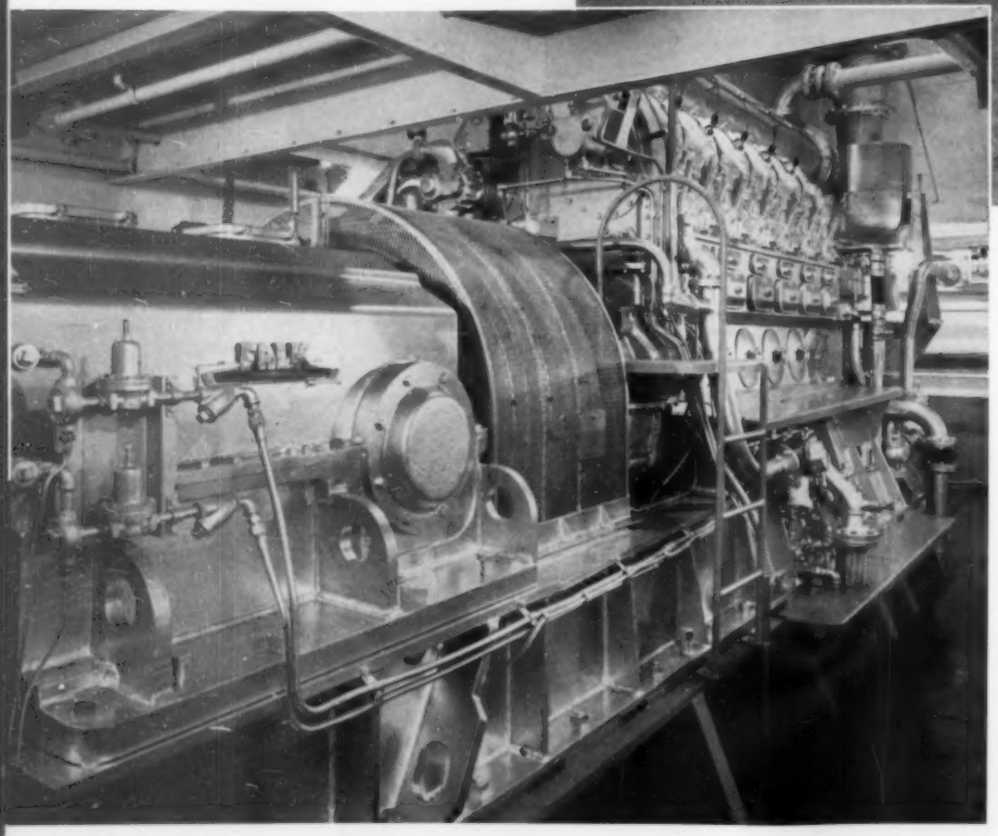
By W. L. BODE

THE towboat, *M/V Oliver C. Shearer,* with 4000 hp of propulsion power, has gone into service on the Ohio and Kanawha Rivers for O. F. Shearer & Sons, Inc., contract coal carriers. The twin engine vessel will handle coal barges for the owners between Charleston, W. Va., and Cincinnati, Ohio. She was built by the Marietta Manufacturing Co., at that firm's yards at Point Pleasant, Va., launched in December, and went into service in February.

The *Shearer* measures 150 ft. long, 42 ft. wide, and 11 ft. 9 in. deep. She is one of the most powerful towboats ever built for coal transportation work according to her builders. Operating draft is 8 ft. 9 in. The pilot's eye level is 30 ft. 9 in. above the waterline.

The *Shearer* incorporates a number of design features to pack maximum push-power without sacrificing maneuverability in shallow waters. The stern is constructed with cutback underside and she is equipped with Kort nozzles to allow maximum flow of water through the propellers.

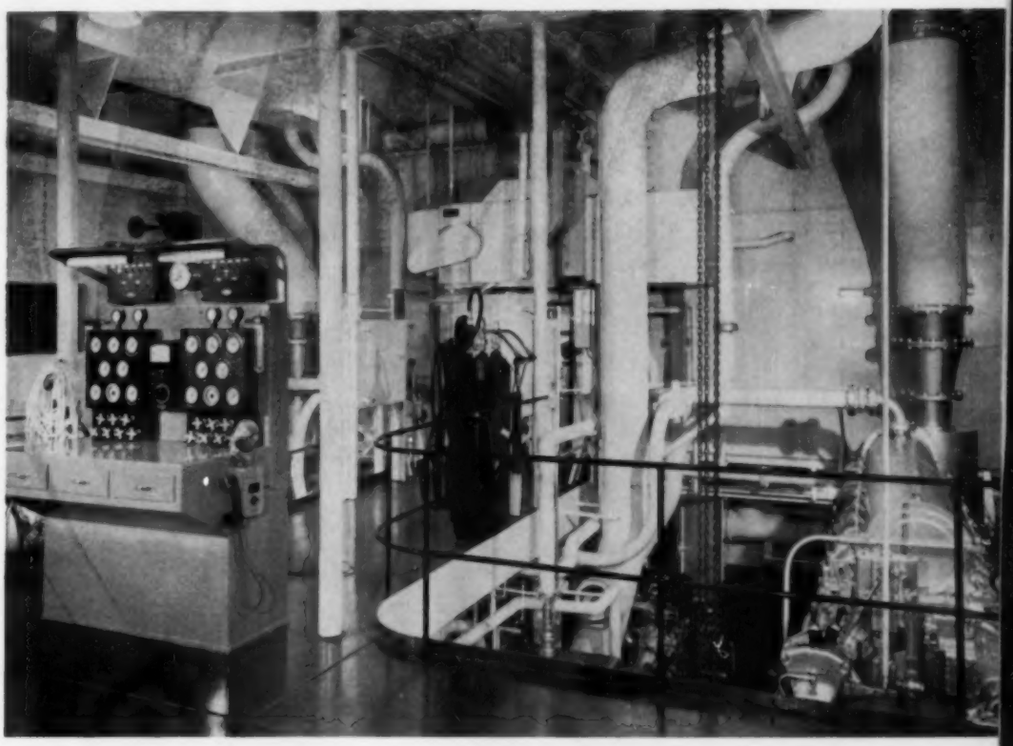
M/V Oliver C. Shearer is 150 ft. x 42 ft. x 11 ft. 9 in., has 8 ft. 9 in. draft. Vessel will handle coal tows from Charleston, W.Va., to Cincinnati; was built by Marietta Manufacturing Company's Point Pleasant, Va., yards.



GM Cleveland model 12-498 diesel engines drive twin propellers through Airflex clutches and Falk 4.5:1 reduction gears. Turbocharged diesels are rated 2000 hp at 800 rpm.

A pair of General Motors Cleveland Division model 12-498 diesel engines provide main power for the new towboat. Each of these engines is rated 2000 hp at 800 rpm. The model 12-498 is a 12-cylinder turbocharged, two cycle engine with bore of 8¾ in. and stroke of 10½ in. for a piston displacement of 7576 cu. in. The engines are equipped for air starting by compressed air system operating at 250 psi pressure.

Each main engine drives through a Falk reduction gear and Airflex clutch. The gears have a reduction ratio of 4.5:1 and give a shaft speed of



View of engine room from starboard side, aft. Engine gauges and alarms are located on control panel at left. To left of main engine can be seen one of two 6-71 diesel generator sets for auxiliary and ship's service power.

approx. 175 rpm. Two Ferguson propellers, measuring 9 ft. 6 in. in diameter and with 8 ft. 6 in. varying pitch turn in Kort nozzles.

Steering is accomplished by independently controlled steering and flanking rudders. Engines are started from the engine room with engine speed controlled from the pilot station. Engine control gauges and alarms are mounted on a panel standing on the main deck between the engines in the engine room.

Two GM Detroit engine-generator sets rated 75 kw and developing 480 volts, 3 phase, ac current, provide power which drives all auxiliary equipment on the *Shearer*. These model 6-71 diesel engines drive Delco generators and also supply power for ship's service.

The *Shearer* is of all-welded construction with one-half inch exterior and 3/8 in. interior hull plating. On the superstructure, exterior bulkheads are of 1/4 in. plate and interiors are of 3/16 in. plate. Jointer bulkheads are of 7/8 in. marinite, with sheathing of 3/16 in. marine veneer. All exposed bulkheads are insulated with 2 in. fiberglass. The *Oliver C. Shearer* is "probably the first towboat to have fireproof construction throughout," according to the builders.

The vessel has capacity for 111,350 gals. of fuel oil, 3750 gals. of lube oil, 39,000 gals. of ballast water, 10,000 of sanitary water and 39,000 gals. of potable water. Accommodations are provided for a crew of eight, seven officers and four guests. Living quarters are heated and air conditioned.

Construction of the *Shearer* cost $1½ million. According to Marietta President Walter M. Windsor, Jr., the vessel represented the largest undertaking by his firm since World War II when Marietta completed a number of fleet tugs, floating dry docks and landing craft for the U. S. Navy. The *Shearer* was designed by Friede and Goldman, Inc., New Orleans, La. Registered gross is 740 tons, registered net is 573 tons.

Principal Equipment

Main engines	GM Cleveland
Governors	Marquette
Air starters	Ingersoll Rand
Fuel oil filters	Purolator
Lube oil filters	Briggs
Exhaust mufflers	Maxim
Temperature regulators	Fulton-Sylphon
Auxiliary generator sets	GM Detroit

Pilothouse levers indicate position of steering and flanking rudders. Pilothouse is equipped with latest navigation, communications equipment.

BOOST LATERAL THRU-PUT WITH AUTOMATIC STATION

Remotely Controlled 1750 BHP Nordberg Diesel Drives Centrifugal Pump on Little Big Inch 14 In. Pipeline To Increase Design Rate To 65,000 BPD

TEXAS Eastern Transmission Corporation's Little Big Inch Division has increased the through-put of its 14 inch products pipeline lateral which extends from Seymour, Ind., to Chicago, Ill., by installation of a remote-controlled automatic booster station. Located near Lafayette, Ind., the approximate mid-point of the 233 mile line, this booster increased the design rate from 45,000 bpd to 65,000 bpd.

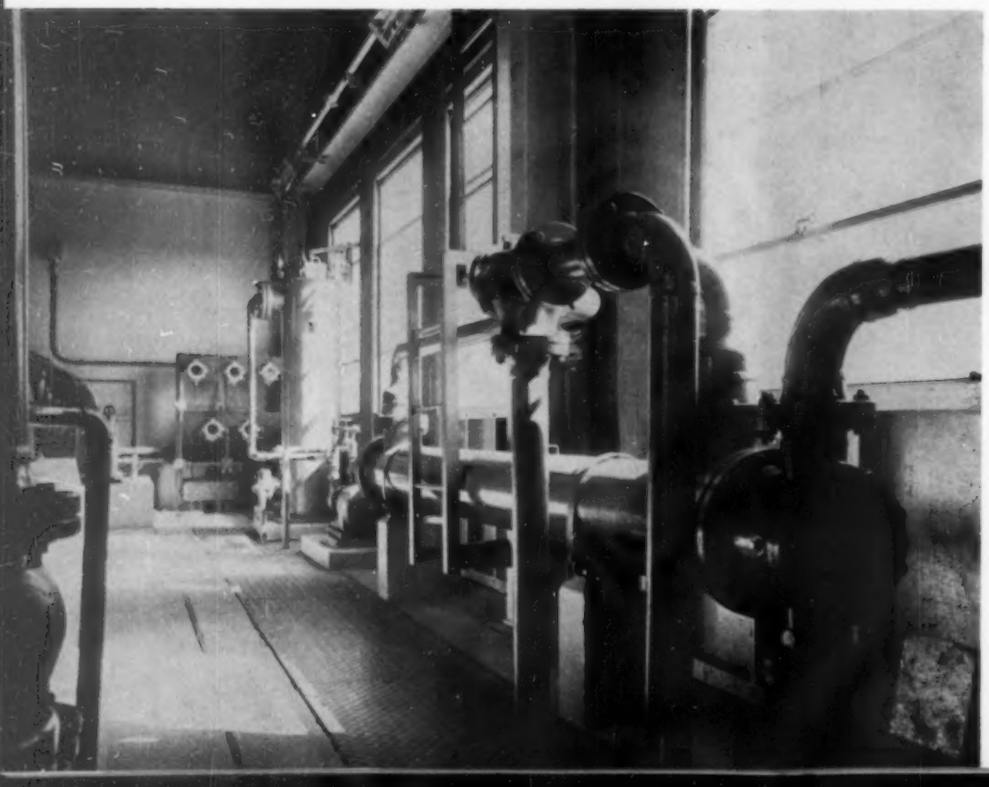
The high demand and seasonal service factor of this station showed an economic justification for selecting an internal combustion engine. This line handles gasolines, diesel fuels, kerosene, and fuel oils, and peak flow is required during the winter months when heating oils are in heavy demand. For seven or eight months of the year, the Seymour station can handle all requirements. Clearly, an internal combustion engine could provide the additional power needed during the four or five peak months without incurring year-round connected-load charges for a big electric motor.

The engine installed at the Lafayette station is a 4 cycle, Supairthermal Nordberg diesel, rated 1750 bhp at 514 rpm. It drives a 6-stage United Centrifugal pump at 3600 rpm through a Western Gear model 300 HS 130 speed increaser with 7.019:I. The station operates on a short by-pass with a check valve for scraper passage.

A major element of interest in this station is the remote control system. Under normal conditions, the station is controlled from the origin station at Seymour. The origin control operator, through a leased wire circuit and a pulse code control system, has three controls allowing him to start or stop the engine and call out local operator. In return, he receives indications that: the station is on, station is off or of scraper passage.

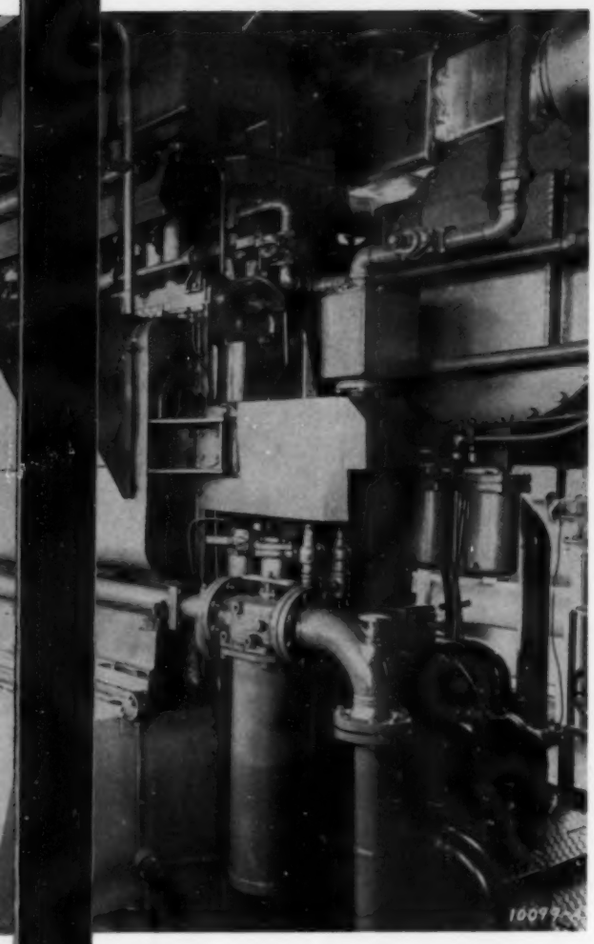
The signal to "start" initiates a completely automated electrical "forced" sequence in which each step is triggered by the successful completion of the prior step. When the start signal is given the main lube filter pump, the crankcase vacuum pump, and the before-and-after pump for gear lube all start at once. When gear lube pressure builds up, the engine lube before-and-after pump is started. Lube pressure then actuates controls that start the fuel oil booster pump and also the jacket water pump. Jacket water pressure starts the radiator water pump. Radiator water pressure, through a series of relays, admits starting air to the engine.

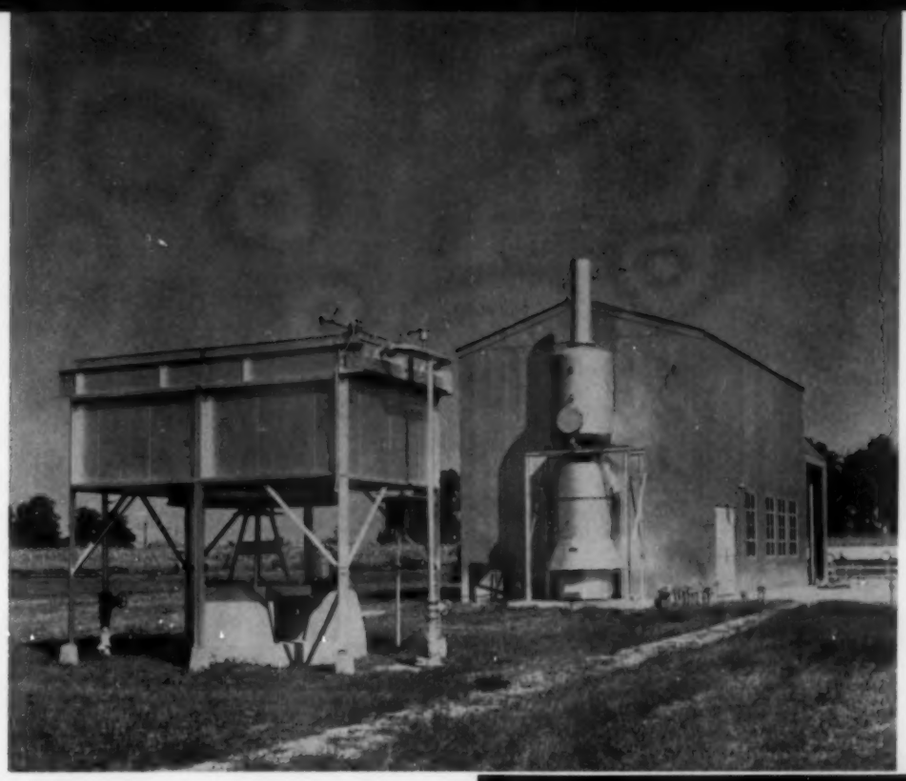
Accessory equipment is grouped around the Nordberg engine. Starting in the foreground, are the Ross lube cooler, Amot thermostatic valve, Tuthill oil filter pump, and Hilco Hyflow lube filter.



Two additional steps follow the starting sequence. First, the main gear lube pump, driven off the gear, builds up pressure as the unit gets up to speed and this pressure then shuts off the b and a pump. Similarly, the main engine lube pump, which is engine driven, develops pressure as the engine starts up and turns off its b and a pump. After all the auxiliaries are in operation, the station suction valve must be opened before starting air can be applied to the engine cylinders for starting. The complete starting sequence requires approximately four minutes from the time of initiation to idling speed, three minutes of which is the time required for the station valve operators. Idling speed (300 rpm) is maintained until the jacket water attains operating temperature, at which time a pneumatic dual controller working through a Woodward type PG governor takes over, increasing engine speed to the desired point.

The "forced sequence" control system for starting was chosen over a programmed or timed sequence because it was felt to be more responsive to existing operating conditions. For example, an arbitrary time sequence would not adapt to changing conditions such as ambient temperature. The forced sequence insures that each step is completed satisfactorily and then proceeds to the next without delay. In addition, it minimizes complicat-

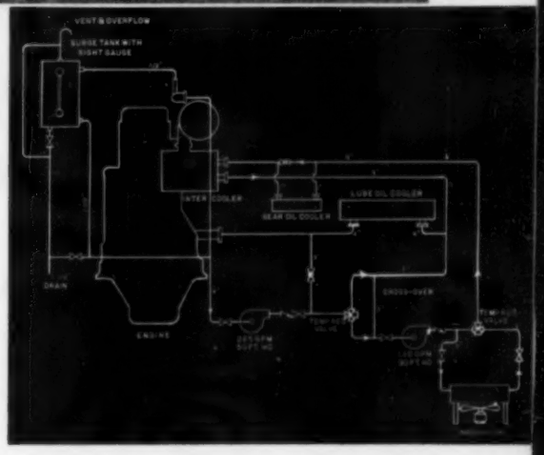




This view of the station shows the Perfex radiator, American Cycoil air filter, and Kittell exhaust silencer.

Pumping power at the Lafayette Station is provided by this Nordberg 1750 bhp Supairthermal diesel. The diesel drives a 6-stage United centrifugal pump. The engine and Western gear are inside the building, the pump outside under the lean-to.

Diagram of cooling water system.



ed circuitry and requires less equipment. Safety devices monitor critical temperature points and pressures and a temporary condition, such as low station suction pressure or high discharge pressure, automatically shuts the engine down. When the condition passes or is corrected, the diesel restarts automatically. In contrast, when a malfunction occurs in the engine system itself, such as high jacket water temperature or low lube pressure, the engine shuts down automatically, but the condition must be corrected, and the shutdown device reset locally before the engine can be restarted.

Most interesting feature of the arrangement of auxiliary equipment is the Nordberg-designed cooling system which could be termed "intelligent water." In this system, the motor-driven jacket water pump, rated at 265 gpm at a 50 ft. head, discharges to an Amot thermostatic proportioning valve which directs the flow either to: 1) a cooling circuit including the main lube oil cooler and the diesel, or 2) to the suction of the radiator water pump, another motor-driven centrifugal rated 110 gpm. at a 90 ft. head. The latter pump discharges to a Young horizontal radiator with an Amot thermostatic by-pass valve, then to the engine intercooler and the gear lube cooler, after which the water joins the flow from the jacket water pump. The combined flow goes through the main lube cooler and the engine, and returns to the suction of the jacket water pump. Finally, there is a crossover between the two outlets of the Amot valve on the discharge of the jacket pump, with water free to flow in either direction.

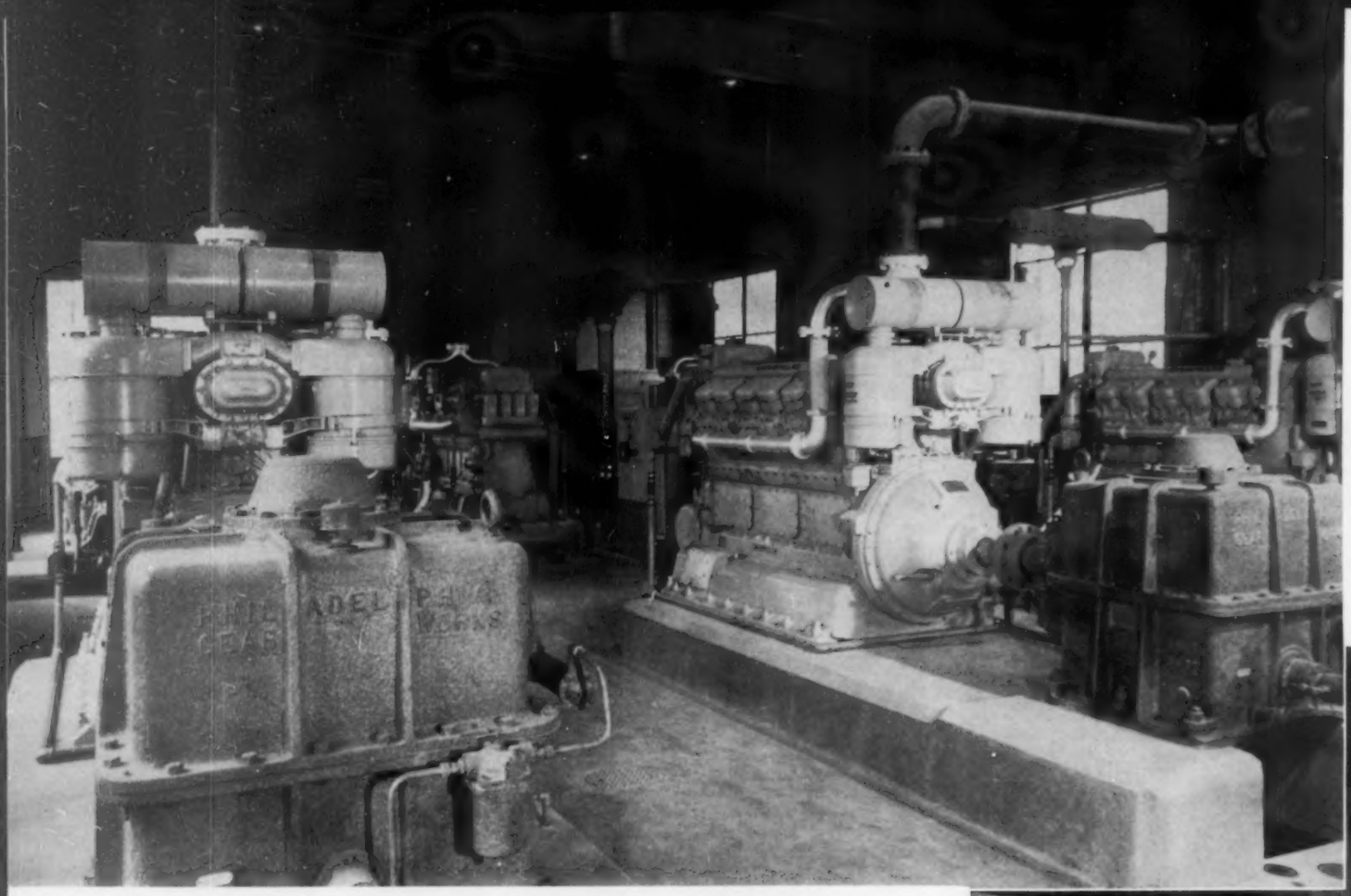
When water in the system is cold, the valve directs flow to the lube cooler-engine circuit, with part going back through the crossover to the suction of the radiator pump. Of course, this water by-passes the radiator until additional cooling is required. As water in the system heats up, the jacket water pump discharge is directed to the suction of the smaller radiator pump with the excess flowing through the crossover directly to the lube cooler-engine circuit, combining on the way with cooled water from the radiator. This combination of two regulating valves, the crossover, and a thermo-statically-controlled two-speed radiator fan provides a highly flexible and sensitive cooling system. In effect, the water is required to seek the proper distribution for cooling all components, hence "intelligent water."

Though predominantly electric, the Little Big Inch is not unfamiliar with internal combustion engines, having a 470 bhp unit at Tyler, Tex. a 375 bhp unit at Lebanon, Ohio, and no less than 15 engines on the Ark-La-Tex system extending from Carthage, Tex., to Arkansas City, Ark. The engine at Tyler and Lebanon can be shut down by remote control but must be started locally. The Lafayette station is the first engine-powered station completely equipped for remote control.

The Lafayette station went into service in December, 1959, and the diesel worked a heavy schedule in December, January, February, and a cold March. Two more booster stations are now under construction on the Seymour-Chicago pipeline, one at Indianapolis, and one near Lowell, Ind., incorporating engine-pump units, almost identical to the equipment at Lafayette.

Lafayette Station Equipment Listing

Engine	Nordberg
Speed increaser	Western Gear
Governor	Woodward
Main lube pump	Viking
Lube pump	Purolator
By-pass lube filter	Hilco
Lube cooler	Ross
Cooling water pumps	Aurora
Radiator	Perfex
Thermostatic valves	Amot
Air filter	American
Exhaust silencer	Kittell
Starting air compressor	Quincy
Exhaust pyrometer	Alnor
Tachometer	Weston
Crankcase vacuum gauge	Meriam



CITY INSTALLS DIESELS TO CONTROL FLOOD AREAS

By ROBERT DYMENT

FLOODING today is a serious problem with many communities throughout the nation. No city knows the problem any better than the New England city of Hartford, Conn., which suffered untold losses in the 1955 hurricanes which ripped through the city and surrounding areas. City and state officials, determined to see that such flooding as followed the hurricane doesn't happen again, took steps to protect the area by installing an entirely new pumping system, which included one of the largest Caterpillar diesel engine installations in the eastern United States.

The earth dike and flood wall along the Connecticut River is an important part of the flood control system which protects Hartford from Connecticut River floods. During normal river stages, surface runoff from the City of Hartford drains to the river. When the river is in flood stage, this runoff is pumped beneath the dike into the river, by the North and South Meadows Pumping Stations. It wasn't so much the river as the land that was causing trouble in North and South Meadows—the lowest sections of land around Hartford.

Seven miles of dikes restrained the Connecticut River. They offered protection against a river stage up to 45 ft. But this didn't keep the Meadows dry. Excess water falling within the Hartford area drained into these two areas. And the existing pumping stations couldn't handle all the water—they had a total capacity of only 108,000 gallons per minute. They needed to move 216,000 gpm from the area.

The situation was serious not only because it involved lives and property, but because Hartford wanted to develop North and South Meadows as Industrial Park zones to attract new industry.

A brief description of the huge job might easily be titled: "Flood Control—City of Hartford." Four storm water pumping stations pump water from back of the dike into the river. South Meadows Pumping Station, because of the lowness of the land, has to start pumping when the river reaches elevation 8 ft. The storage pond elevation is kept down to about elevation 5 ft. North and South Meadows are the lower sections of the Hartford area and excess water falling and draining within the Hartford area runs to the lower sections and must be pumped out.

North and South Meadows are two miles apart. Before installation of the D397's, the pumps were operated by electricity and gasoline engines. The reason for the change to diesel were twofold: More capacity was needed at higher river levels after experiencing the 1955 hurricane and the gasoline engines were becoming obsolete and parts hard to get when required.

General view of the South Meadows pumping station. Six Cat D397 supercharged engines, each driving a 36 in. pump through Philadelphia Gear Works reduction gears are installed here, four more are at the North Meadows Station. The Cat engines are each rated 450 hp at 1200 rpm.

The South Meadows Pumping Station, built in 1930, was originally equipped with four 36 in. mixed flow volute pumps, each driven by a direct connected 250 hp synchronous electric motor. The North Meadows Pumping Station was built about 20 years ago and was initially installed with three 36 in. mixed flow volute pumps, each driven by a 250 hp gasoline engine. Building development in the North and South Meadows area, reclaimed by dike construction, made it advisable to consider increasing the capacity of these stations. The hurricane flood of August, 1955, made this need even more apparent.

At the South Meadows Station the four electric motors were removed and replaced by four Caterpillar D397 diesel engines. This involved new pump impellers and right angle gear units. Also, two complete units (engines, gears and pump) were added, making a total of six pumps in this station, each powered by one of the 450 hp engines.

At the North Meadows Station the three gasoline engines were removed and replaced by three D397 diesel engines. This also required installation of new pump impellers and right angle gear units. One additional complete unit (engine, gear, and pump) was added, making a total of four pumps in this station, each powered by a D397 engine. These changes more than doubled the pumping capacity of these stations.

The D397's are V-type, 12 cylinder engines with 5¾ in. bore and 8 in. stroke. The engines are mechanically supercharged with Roots type blowers, and turning at 1200 rpm, are rated 450 hp.

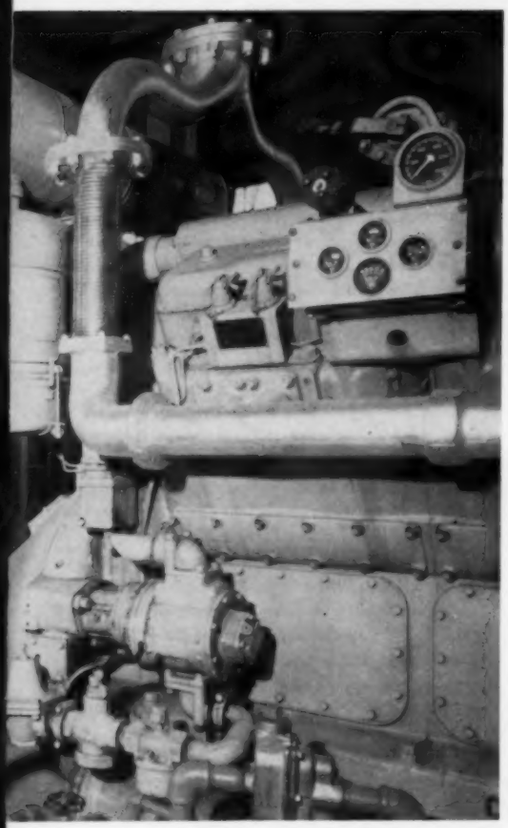
The engines drive vertical pumps through Twin Disc friction clutches and Philadelphia Gear Works reduction gears. Reduction ratios of the type BV gears vary to suit the existing and new pumps. Seven of the pumps are 36 in. Morris Machine Works units and three are De Laval 36 in., type.

The pumps, being of different makes, vary in speed from 400 to 600 rpm and pump against a 40 ft. maximum head. Of six pumps at the South Station, four can handle 38,000 gpm while the other two are rated 37,000 gpm for a total pumping capacity of 226,000 gpm for this station. Of the four engine-pump units at North Station, three are rated at 38,000 gpm, the other at 37,000 gpm for a total pumping capacity of 151,000 gpm. The South Station handles water from an 1100 acre area, the North Station is responsible for an 800 acre section. The capacity is based on a 10 yr. rainfall curve determined from a 35 yr. record.

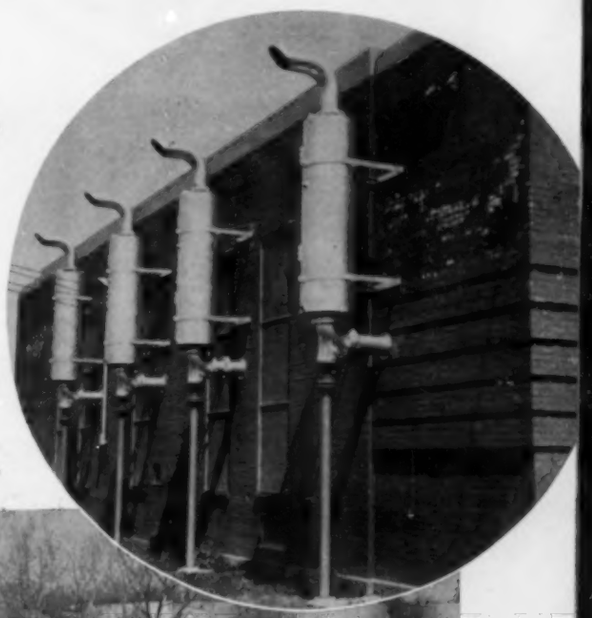
Each Cat D397 diesel engine is equipped with a Ross heat exchanger for fresh water cooling and Amot regulators are installed on the raw water lines to conserve city water. The engines are also equipped with safety shutdowns for high water temperature and low lube oil pressure, overspeed control. Viking audio-visual alarms are also installed to warn of the above conditions in advance of shutdown. All the engines are equipped for air starting from electrically driven compressors and dual 32 cu. ft. receivers, and with cold starting devices. There is a 20,000 gal. fuel storage tank at South Station; North Station has 10,000 gal. storage capacity.

A D318 standby generator set at the South Station is used to power starting air compressors and flood gates in the event of public power failure. This set consists of a Cat D318 engine with 4½ x 5½ in. bore and stroke and rated 60 hp at 1200 rpm, driving an Electric Machinery Co. generator, type CPLD, which is rated 625 kva 120/208 volts, 60 cycle at 1200 rpm.

Both the stations are standby installations and operate only 30 to 60 days per year, when the Connecticut River is above flood stage. As a result of the improvement to the pumping stations they now get rid of water much faster and stay ahead of water coming in. Metcalf & Eddy, consulting engineers, worked with area officials, as did Phillip Pierce, engine representative for the H. O. Penn Machinery Co., Inc., in planning the new installations. The Greater Hartford Flood Control Commission, responsible for overall operations, is a separate entity appointed by the state's governor.



A view of the four Maxim silencers installed at the Hartford North Meadows station.



Right side view of one of the ten Cat D397 engines in the Hartford flood control system. Engine drives gear through Twin Disc friction clutch. Air for each bank of six cylinders is filtered through a Donaldson oil bath air cleaner.

Exterior view of the South Meadows station. This unit pumps water from 1100 acre area, North Meadows station drains 800 acre tract.

ENGINE-GEAR SET HAS NEW CONTROL FEATURES

Nordberg Demonstrates One of Four Diesels for Dravo Built Union Barge Line Towboats. Controls Automatically Monitor Exhaust Temperatures and Minimize "Black Stacking"

By ROBERT E. SCHULZ

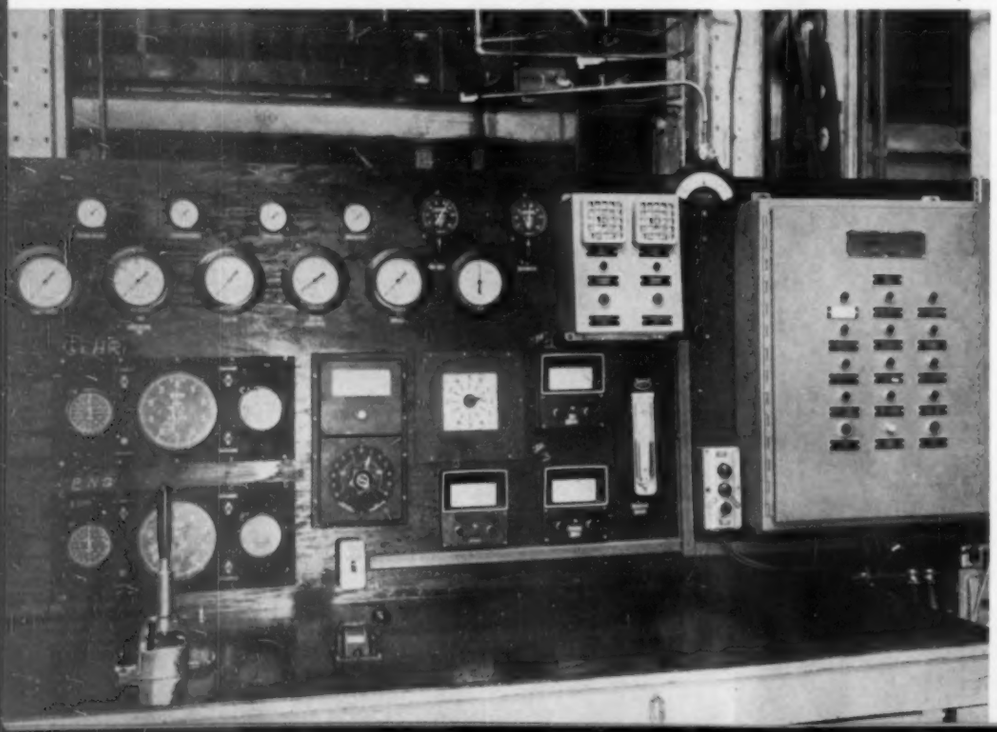
RIVER towboats have often been referred to as "floating power plants." And this is a rather apt description. Marine operators demand maximum power availability and, because of river and load conditions, are now seeking the type of automatic control for their power plants more generally used in "land locked" installations. Thus it is that reliability, operating economy and instrumentation are receiving such heavy emphasis not only by the boat operators, but by the companies that produce the propulsion systems. Indicative of this was an operating demonstration and symposium held recently by Nordberg Mfg. Co. at its Milwaukee plant. On hand were a group of engineering and operating officials from the marine industry and government branches. The one-day session well typified the way the engine, gear, control and other component manufacturers are working together to reduce operating costs and boost efficiency on the waterways by supplying equipment specifically tailored for the job.

Attention in the operating demonstration was focused on one of the four engine-gear sets Nordberg is building for two Dravo constructed Union Barge Line towboats. These towboats, as yet unnamed, are twin screw vessels 190 ft. in length built for operation on the lower river. On demonstration was the port diesel for the second boat—a four-cycle, 12 cylinder V-type engine using the Supairthermal system and rated 3200 bhp—174 Bmep at 514 rpm.

The engine-gear set was full load tested using a large hydraulic dynamometer. Gear for this application is the Western Seamaster model 320 PCMR-AH reverse-reduction unit with a ratio of 2.77:1, and equipped with dual Wichita externally mounted air actuated clutches. The input quill shaft of the gear flanges directly to the engine flywheel and all input torque is transmitted through this shaft. The Wichita pneumatic clutches, mounted fore and aft on the gear as illustrated, control ahead or astern rotation.

A large part of the demonstration on the Nordberg assembly and test floor was given over to the Nordtronic engine control which will be aboard the Dravo towboats. Incorporated into this control is a new system for automatic and continuous monitoring of exhaust temperatures. This system, built by Alnor Instrument Co., is designed to eliminate the need for periodic, manual checking for high or low temperatures on each engine cylinder. It includes a special motorized switch with modified circuitry (12 point scanner), and a temperature differential double target Pyrotroller with a scale range of –300 to 0 to +300° F. Working together, these components provide the following automatic action: The motorized switch automatically and continuously scans each individual cylinder. The load balancing Pyrotroller then automatically relates each cylinder temperature to the automatically computed average of all the other cylinders. This is accomplished in approximately 5 seconds per cylinder. An alarm is sounded when, and only when, an individual cylinder exceeds or falls short of the automatically computed average by whatever pre-determined value has been set. The limiting pointers are adjustable; for example, if the limits are set at 100° plus or minus and if a cylinder exhaust temperature should exceed that range of variation, an audible alarm and light system would be actuated. For demonstration purposes, this was done by increasing the fuel pump rack on one cylinder until the alarm sounded, red light flashed on, and the scanning pointer stopped at the cylinder in trouble.

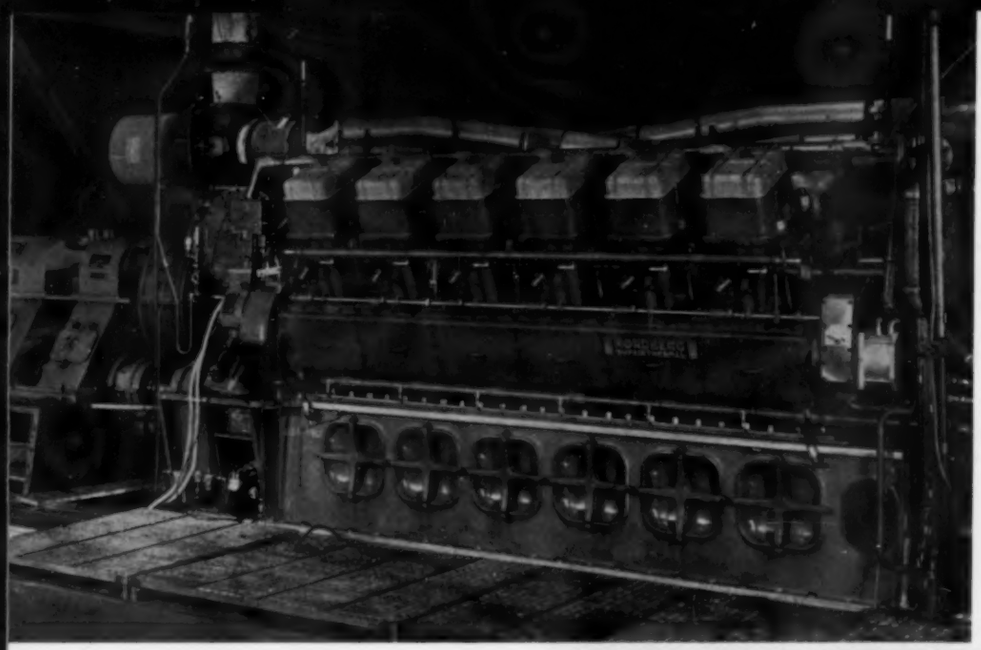
Close-up of the Nordtronic engine control board with the Alnor exhaust temperature monitoring pyrometer and scanner and the remote alarm panel with alarm buzzer and signal light for two engines to be installed in a Dravo built towboat.



In addition to the pyrometer scanner, there are two separate pyrometers for measuring the preturbine temperatures. If the preturbine temperature of either turbocharger should go above a safe limit, the alarm will sound.

With the Nordtronic control system, certain of the functions being monitored will indicate only in the engine room while other vital functions such as high exhaust temperatures, low lube oil pressure, etc. will activate an audible and visual alarm in the remote location as well.

The alarm panels furnished contain the necessary pilot lights, pushbuttons, and required relays. The system is designed as a fail safe unit. If an abnormal condition should occur, the pilot light on the function concerned will go out. The alarm light will go on and the audible alarm will sound.



Port engine-gear set for one of two 6400 bhp towboats now being completed for Union Barge Lines by Dravo Corp. Nordberg 3200 hp Supairthermal V-12 diesel drives through Western reverse-reduction gear equipped with Wichita air clutches to the test hydraulic dynamometer.

Engineering and operating personnel of marine industry and government were guests at the operating demonstration and symposium.

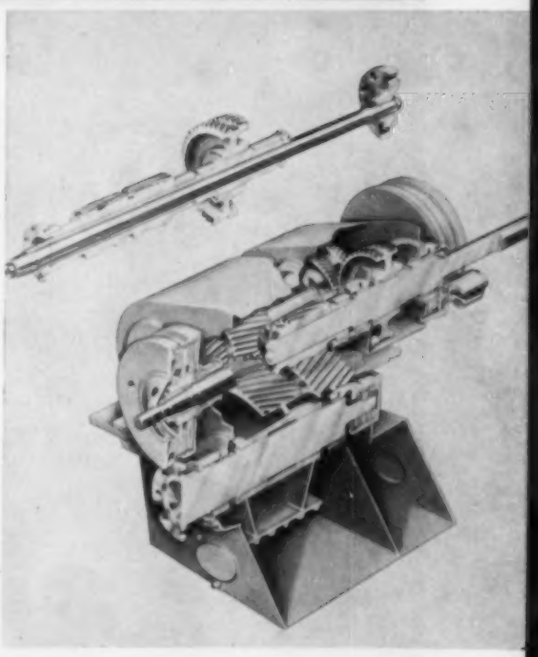
The operating engineer can then silence the horn by depressing a button. However, the alarm condition indicating light will remain on until the abnormal condition is corrected. The alarm horn system has been arranged so that should a second abnormal condition occur before the first one is corrected, the horn will again sound.

The remote alarm panel that will be installed in the pilot house of the Dravo towboats consists of a buzzer and a single red light for each engine. When an emergency occurs that would normally require shutdown of an engine, the red light will come on and the audible alarm will sound. The pilot at that time must take into consideration the position of his tow and decide whether or not to shut down the engine.

Also of special consideration during the demonstration was a fuel limiting device to minimize "black stacking." The fuel limiting system is basically a cam program operated by the Westinghouse Air Brake single lever control. Black stacking normally occurs during periods of heavy acceleration—a condition caused by excess fuel in the cylinder. With this system, the cam sends an air signal to the Woodward pneumatic governor which actuates the governor speeder spring to establish the desired engine speed. There is, however, built into this governor a fuel rack limiting device which limits the maximum fuel quantity at the lower engine speeds. This prevents heavy firing at low speeds and as speed increases, the load limit is raised. The engine was run with the limiting device engaged and then disengaged. This visually demonstrated optimum accelleration without "black stacking."

The Supairthermal system on this model FS-1312-HSC Nordberg engine basically incorporates: high pressure turbocharging (in this case twin 2.7:1 pressure ratio units); cooling of the inlet air after the turbochargers; and variable inlet valve timing.

During the demonstration with the engine at full load, the air pressure delivered by the two Elliott turbochargers was about 35 in. Hg (or 17.2 psi) and the average cylinder exhaust temperature was about 800° F. Corrected fuel consumption according to Nordberg officials under these conditions was .355 lbs./bhp/hr. Two oscilloscopes were used, each connected to a cylinder to show the difference in operation of the engine with and without Supairthermal equipment. Cylinder pressure time diagrams on the oscilloscopes showed pressures approximately as follows: compression pressure 750-770 psi; firing pressure 980-1000 psi. The compression pressure is controlled under the Nordberg system, by closing the inlet valve at about 15° before bottom center. This results in an air manifold pressure of about 17 psi, but a pressure at bottom center or the beginning of compression of only 9 to 9.5 psi. Net result according to Nordberg is a greater charge of air per cylinder with peak pressures lower than would be encountered with a conventionally turbocharged engine.



Cutaway of the Western Seamaster model 320 reverse-reduction gear with 2.77:1 ratio and equipped with dual Wichita air actuated clutches that will be used in Dravo boats. Input quill shaft flanges directly to the engine flywheel. Clutches control ahead or astern gear rotation.

For Smaller High Speed Diesels . . .

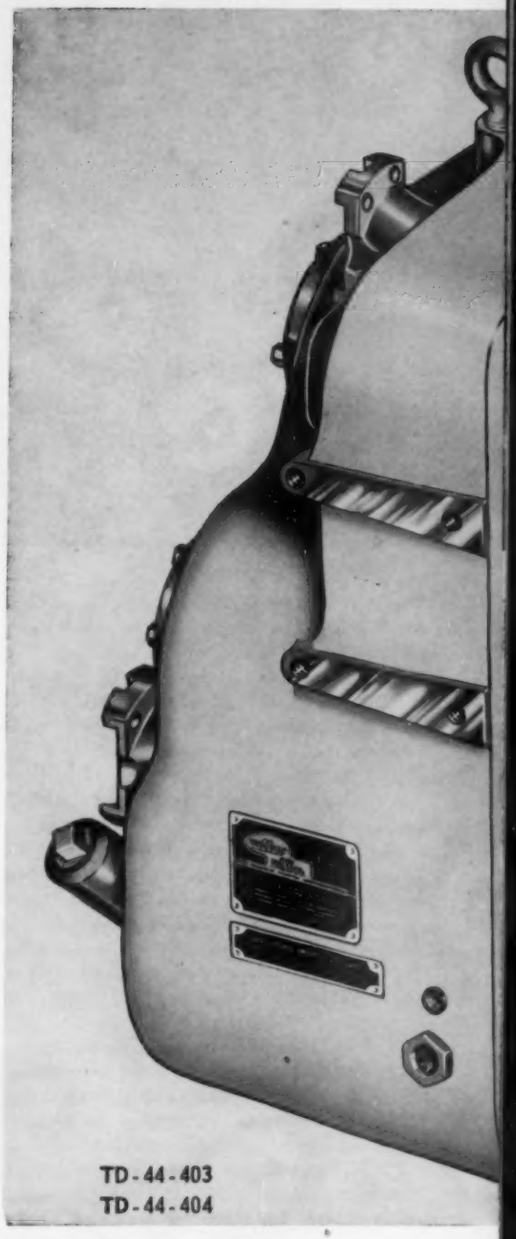
A NEW EIGHT-SPEED POWER SHIFT TRANSMISSION

Twin Disc Adds to "Engine to Axle" Line with TD-44 Series Available in Two Models for Engines in 85 HP Range; Units Have Counter-Shaft Design, Used with Sumpless Converter

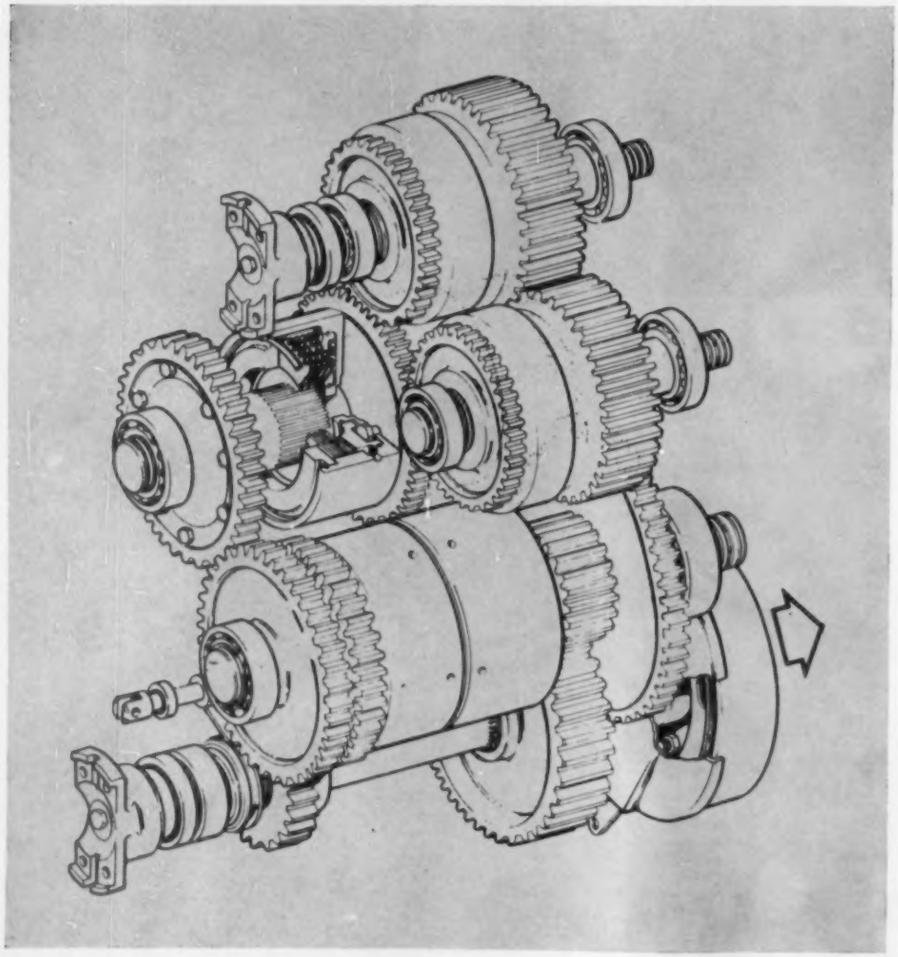
By DOUGLAS SHEARING

CONTINUING the expansion of its line of power train components, Twin Disc is now producing a new TD-44-400 series transmission designed for use with engines of approximately 85 net maximum horsepower at a normal engine governed speed of 2200 rpm. The maximum engine net torque is 220 lbs. ft. This is a four speed forward, four speed reverse box with full power-shifting ability in all speeds. Two models, each with a different set of ratios, provide an overall ratio coverage of 6.91:1. The model TD-44-403 has ratios of 4.89, 3.19, 1.08 and .705. The TD-44-404 has ratios of 5.98, 3.92, 1.32 and .866.

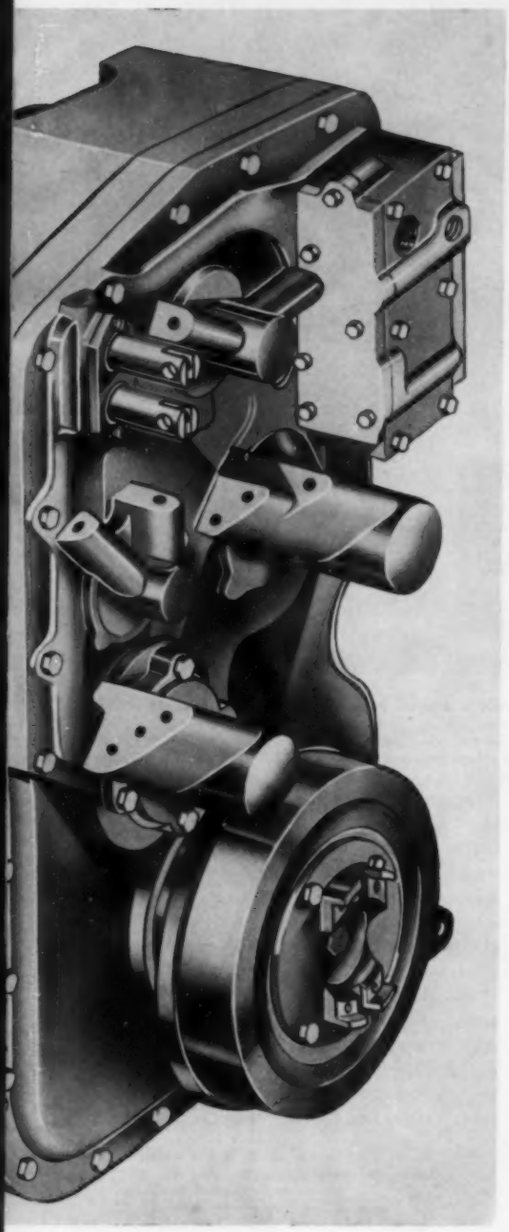
This drop box transmission is normally furnished with a 1300 series Twin Disc single-stage sumpless torque converter as a package well suited to front end loaders, large fork lifts, motor graders and industrial type tractors. The converter and transmission are mounted independently with a yoke-type universal joint functioning as the connecting member. The torque converter housing fits a standard SAE #3 engine flywheel housing and the converter itself features two power take-off points. Usually one is used in conjunction with the vehicle hydraulic steering circuit. The other incorporates an SAE "C" pump mounting which can be used for a hydraulic power pump. Oil supply pump for the converter-transmission package also is mounted on the converter.

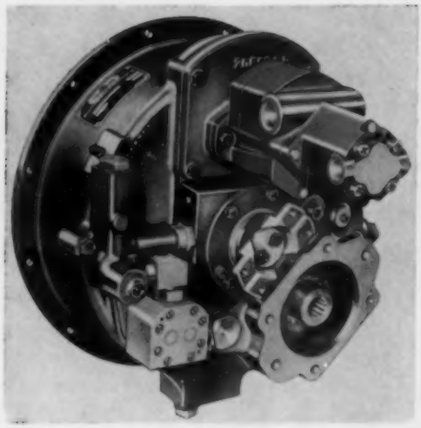


Product view of TD-44 series transmission. New unit has four speeds forward, four in reverse with overall ratio coverage of 6.91:1. Transmission is designed for engines of approx. 85 net max. hp.

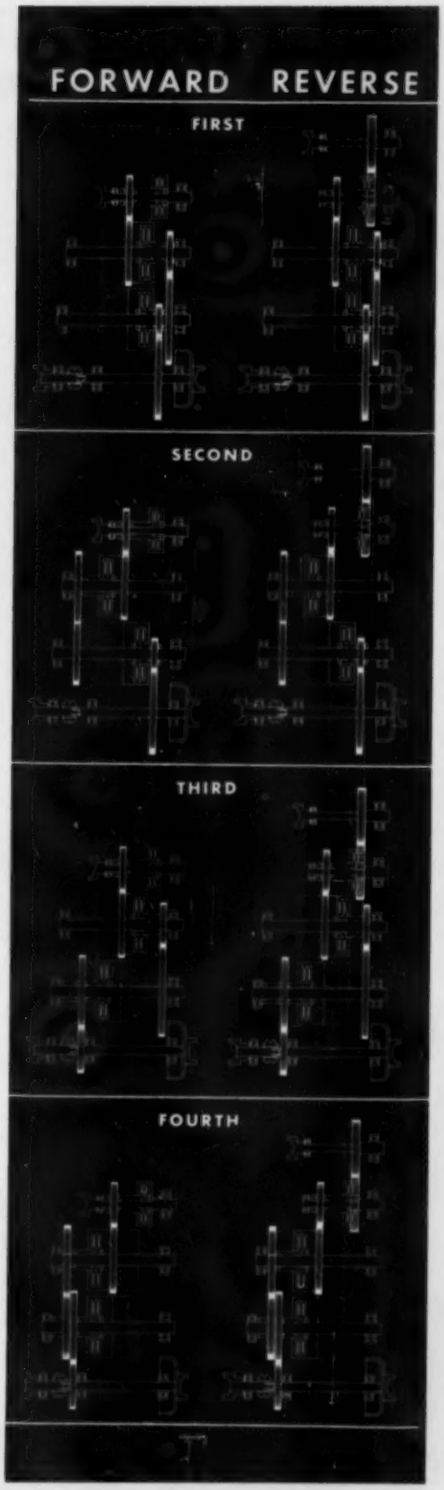


Countershaft designs of new series TD-44 full power shift transmission by Twin Disc.





New transmission is normally furnished with 1300 series sumpless torque converter, above. Converter features two power takeoff points, one for power steering and lower pto with pump mounting which can be utilized for hydraulic power pump.



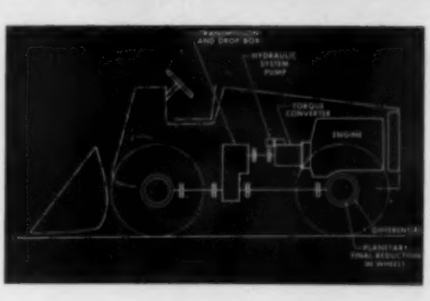
Diagrammatic views of the four forward and reverse gear ratios of TD-44 series transmissions.

This smaller transmission follows the introduction of Twin Disc's model TA-51-2000 series powershift units for off-highway vehicles to 420 hp (see November 1960 issue of D&GEP pages 40-41). Now taking a look at these new series TD-44 transmissions they are designed to permit ratio selection at full engine speed in all ranges. This feature is attained by straight-through, countershaft construction with constant mesh gears and multiple-disc, hydraulically actuated clutches. With this design gear changes can be made on uphill grades without power interruption or loss of momentum. Gear raking is also eliminated when a down-shift is faultily executed.

The transmission features two single clutches, which are the direction clutches, and two duplex clutches that function as range clutches. Both direction clutches are oil-actuated and oil-cooled. These clutches also function as energizing clutches for all engagements. The oil-actuated and splash-cooled duplex clutches provide the four speed selections in both directions of travel. Sintered-bronze clutch plate surfaces are used for maximum coefficient and resistance to "welding." Since the clutches are oil-actuated, they are, of course, self-adjusting. The range clutches do not have a neutral position since they are engaged prior to the energizing direction clutch. All clutches are centrifugally oil pressure balanced.

The pressure regulators, selector valves, and the brake regulated clutch release valve are mounted on the transmission. A cascade system of oil pressure regulation is used in this transmission for clutch engagement. A controlled pressure rise valve increases the pressure steadily and rapidly for smooth clutch engagement. The brake regulated clutch release valve is ported for direct connection to the vehicle brake fluid system. Therefore, when the brake pedal is depressed, all clutches in the transmission are released which immediately cuts off the power source for vehicle movement.

Both ends of the output shaft are equipped with yoke-type universal joint connecting members as standard equipment. Also, a parking brake and a disconnect jaw clutch are installed on the output shaft as standard equipment. The disconnect jaw clutch may be engaged for four wheel drive operation or disengaged for single axle drive functions. The transmissions have been designed for easy servicing. Removing the main housing cover permits access to all clutches and range gears.



Drawing shows typical arrangement for torque converter and transmission on a diesel front end loader.

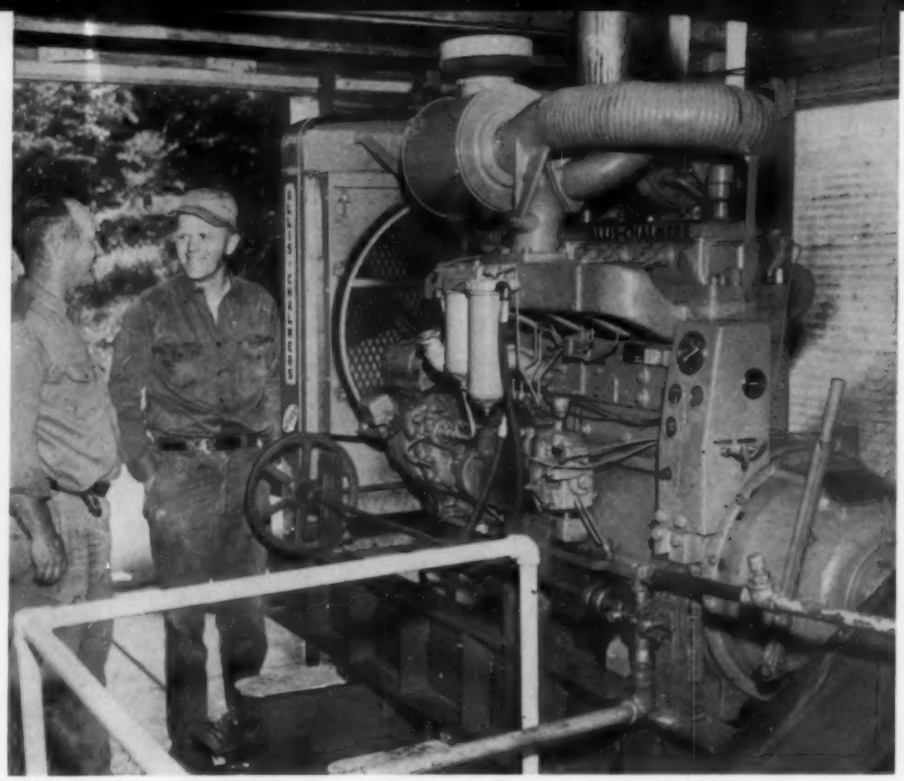
REPOWERING UPS OUTPUT OF DREDGE

WHEN repowering, the engine buyer is usually looking for either improved fuel economy, added or reserve horsepower or, as likely, both benefits, in his new engine. And, more and more engine buyers are finding out that what the engine builder says is true: Today's new engines, with their improvements, can deliver more power with lower fuel consumption. Typical of this experience is that of the Fauver Bros., dredging contractors at La Crosse, Wis. When the Fauver brothers, Joseph and Frank, decided to replace the engines on their dredge with new units they chose an Allis-Chalmers model 344 unit to power their cutter and accessory machinery and an A-C model 21000 engine for the sand pump.

When we visited the brothers at La Crosse recently, they were just completing a filling contract for the 250 bed La Crosse Lutheran Hospital and adjoining Gundersen Clinic. The contract called for filling a two acre plot to raise the level 32 ft. to bring the tract to the level of the hospital grounds. Plans call for use of the newly reclaimed land for a parking lot and for possible future expansion of the hospital.

Dredging from Swift Creek which adjoins the property, the brothers put a total of 135,000 cu. yds. of material on the tract to bring it to the specified grade. The average pumping distance was 600 ft. with a lift of 30 ft.

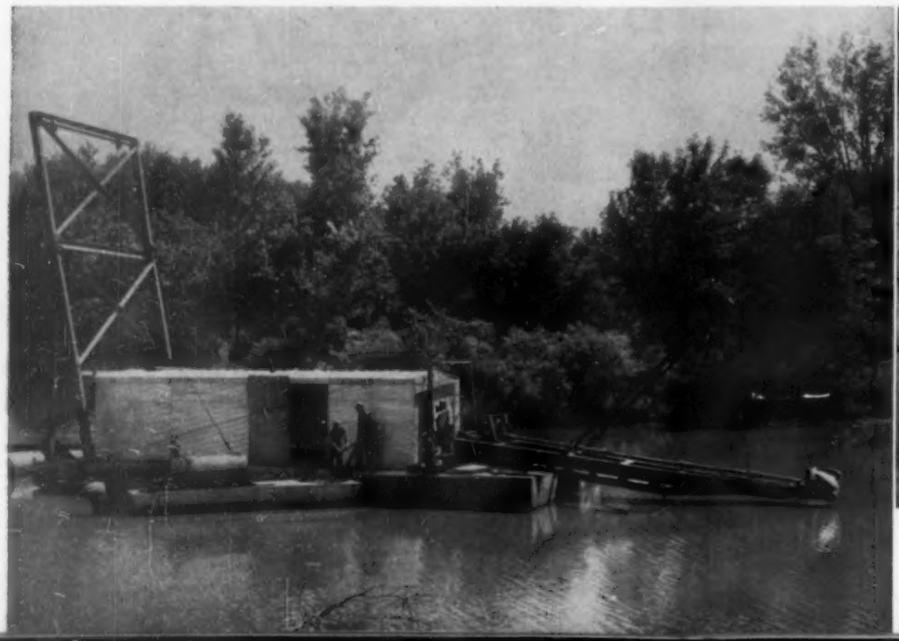
The model 21000 engine drives the main 8 in. Morris model CK sand pump. In this operation the engine runs 20 hrs. a day pumping about 100 cu. yds. of sand per hour. The 21000 engine, with bore and stroke of 5½ x 6½ in., is a turbocharged unit rated 240 cont. hp at 1800 rpm. The six cylinder engine has a total displacement of 844 cu. in. The engine drives the Morris pump through a Twin Disc power takeoff and a Browning Poly-Drive belt. A pulley ratio of 2.4:1 reduces the 1800 rpm engine speed to 750 rpm at the pump.



Allis-Chalmers model 21000 diesel engine drives a Morris 8 in. sand pump on the Fauver dredge through a Twin Disc clutch power takeoff. Engine is turbocharged unit rated 240 cont. hp at 1800 rpm. Shown are Joseph and Frank Fauver, owners of the dredge. Note American Bosch fuel pump.

The Allis-Chalmers model 344 engine powers a five drum hoist and the orbiting cutter on the dredge through a multiple V-belt drive off the rear of the engine. A small, 2.2 kw generator "to help keep the coffee pot warm" is driven by a V-belt from the front engine pulley. The 344, with bore and stroke of $4\frac{7}{16}$ x $5\frac{9}{16}$ in. is rated 72 cont. hp at 1800 rpm. This four cylinder, 344 cu. in. displacement engine is naturally aspirated.

"Our whole operation has increased in efficiency by 30 per cent," said Joe Fauver in commenting on the new installation. "The 21000 engine runs for 20 hrs. on the same amount of fuel that the engine it replaced did for 13 hrs. We find that there is a great deal more reserve power in both new engines and we don't have to be afraid of overloading them. Fuel consumption averages 12-13 gals. per hr. for both engines, about the same," the brothers said, "as the fuel consumption required for the old pump engine they replaced. However, we're getting more power and the job done quicker." The engines were sold by Drott Tractor Co., Inc., Milwaukee.



Fauver Bros. dredge, shown at location near La Crosse, Wis., was repowered with pair of Allis-Chalmers diesel engines. With new power, operators increased efficiency of operation about 30 per cent.

Model 344 engine drives a five drum hoist and orbiting cutter through a Twin Disc power takeoff and multiple V-belt drive. Engine is rated 72 hp at 1800 rpm. Note Donaldson air cleaner.

BUILDERS REPORT ON MILITARY MULTIFUEL ENGINE TRUCKS

By JIM BROWN

SEPARATE contracts totaling over $4¼ million for the manufacture of 18 prototype medium duty 6x6 and 8x8 diesel trucks were recently completed for the U. S. Army by three automotive manufacturers: GMC Truck and Coach Division of General Motors, the Ford Motor Co. and the Reo Division of the White Motor Co. Each of the contracts covered the manufacture of three each of the 6-wheel, 6-wheel drive (6x6) and 8-wheel, 8-wheel drive (8x8) vehicles which are currently being given a series of exhaustive tests under controlled conditions to determine performance, endurance and maintenance characteristics.

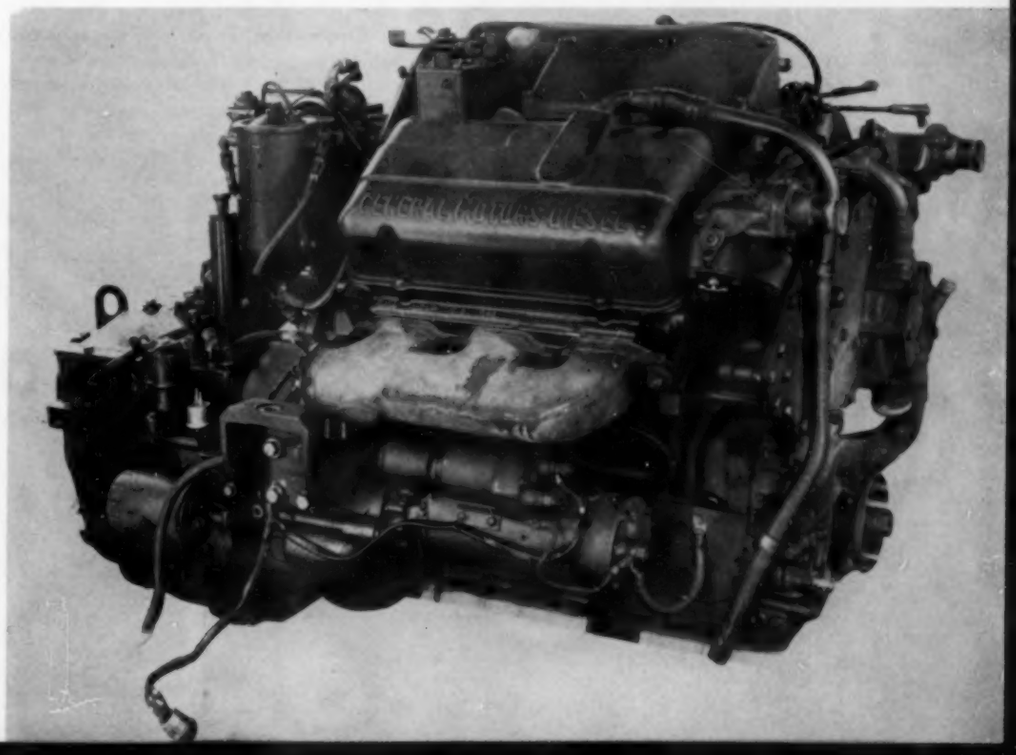
The vehicles were designed for the U. S. Armed forces for the transportation of personnel, cargo and other military supplies and equipment and for special tasks during tactical military operations. Since it was considered likely that the 3½ ton and 5½ ton capacity vehicles might in emergency have to be transported by air one of the contract stipulations was that they be suitable for air lift and air drops. Besides having the greatest practical mobility an interesting requirement was that they be capable of floating on inland waters and negotiating such obstacles under their own power.

Another, and to us an interesting stipulation, covered the types of fuel upon which the vehicles will be required to operate satisfactorily. The objective was to obtain multifuel operation both for economy and convenience. It is not required that the vehicles run on "anything" including whale oil (which would be pretty hard to find) but they *are* required to give satisfactory operation on three specific fuels. These are diesel fuel (Army specification VV-F-800), "compression ignition fuel" (Mil.-F-45 121, similar to JP4 jet fuel), and combat grade gasoline (Mil.-G-3056).

The U. S. Army's post-war use of diesel engines for tanks and wheeled vehicles dates back to 1957 when certain war-imposed fuel procurement restrictions were removed. Since then the Army Ordnance Tank-Automotive Command has evidently shown more interest in diesel engine developments. The first such engine to get into production for Army use was the Continental 750 bhp air-cooled diesel which is used in the M60 Tank. This engine has the same configuration and space requirements as the gasoline engine it replaces. Because of an earlier military contract, the White Motor Co. had already converted their Gold Comet heavy-duty V-8 gasoline engine to diesel and had it available for use in the medium-duty trucks described here. The Ford Motor Co. also has a V-8 diesel, converted from a heavy duty gasoline truck engine for this medium duty vehicle program. The 6V-53 diesel engine currently applied to the medium-

Rough terrain and loose soil hardly even slow up this Ford medium duty diesel truck as it was demonstrated for military men at Ford's Michigan Proving Ground.

The 6V-53 2-cycle diesel which powers the GMC medium duty truck prototypes. Roots-type rotary scavenging blower is nested between the cylinder banks. All accessories are gear driven, which does away with requirement for belts.

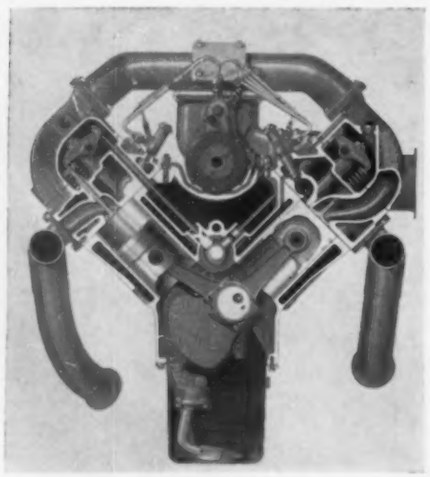


GMC's new medium-duty tactical military vehicles can transport troops and cargo on land or through the water. Afloat, the trucks are propelled by the rotation of their wheels. A propeller drive and rudder are also available by kit installation. Fabric air scoop at front keeps water from engine compartment.

duty trucks by GMC is also a "special" job with certain characteristics specifically designed for military use in a previous experimental vehicle, an armoured personnel carrier. It is evident that maintenance savings are being stressed in the design of the prototype trucks as they include long-lasting Teflon bushings wherever possible, "one shot" lubrication and other features designed to lessen requirements for maintenance attention.

The axles chosen by all three of the truck prototype manufacturers are products of the Rockwell Standard Corp. of Detroit, a consolidation of the former Timken-Detroit Axle Co. and Standard Steel Spring Co.

Transmission for both 6x6 and 8x8 trucks of all three types are synchro-mesh, manually shifted. Transmissions in the Ford offerings are Dana model 5464, GMC Truck also chose Dana transmissions but the Reo transmissions are Clark LT 4578. The Ford trucks have 6 forward speeds; the GMC's 4 forward speeds with a 2-speed auxiliary transmission; the Reo truck transmissions have 5 forward speeds and employ a converter. The Ford truck transfer cases are built by Dana Corp.; GMC's by Rockwell Standard and Reo's by Clark Equipment Co.



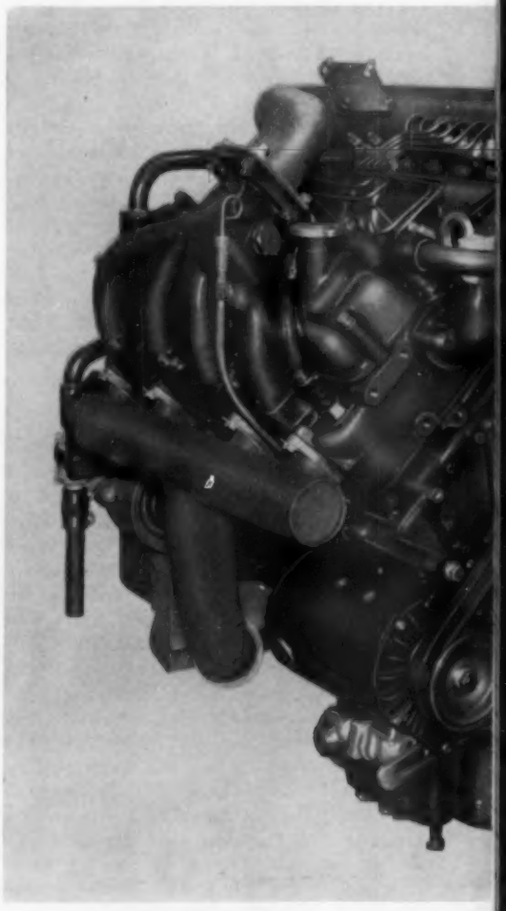
Cutaway view of the Ford DV8-534 engine, showing Hispano Suiza type combustion system, Robert Bosch fuel pump and injectors, etc.

Two "Wet" Engines; One Dry

To meet the waterbourne requirements, both the Ford and Reo engines are designed to operate under water, but GMC chose to waterproof the engine compartments by providing a wedge-shaped fabric air scoop which snaps on in front of the radiator. Some forward propulsion of the trucks in the water is to be had by engaging both front and rear wheel drives. Provision is made for development of water propulsion kits with which they can make from 6 to 8 mph in the water. Top speeds on land will be in excess of 50 mph. Considerable variation is to be found in the cab and body designs although, for the sake of minimum weight, they all employ aluminum construction. The bodies are made watertight by gasketing.

GMC Military Engine

The engine employed by GMC for both the 6x6 and 8x8 military trucks is the 6V-53, 2-cycle diesel engine with 190 gross hp at 2800 rpm. Especially adapted for military service, provision is made to gear-drive all accessories, which does away with the fan belt. Emphasis was placed on "elimination of service or repair over long operating periods" throughout the trucks, according to GMC, and this applies to the power plants as well as the chassis. An easily accessible dry type air cleaner and accessible oil filter are provided, an oil-cooled generator and a transistorized voltage regulator.



Ford's DV8-534 Military Diesel Engine of 195 bhp at 3000 rpm.

The engine provided for the XM-453-E2 and XM-434-E2 medium trucks built by Ford's Special Military Vehicles Operations is a V-8 gasoline engine conversion known as the DV8-534. To the best of our knowledge this engine has to date received very little publicity.

Ford's DV8-534 is a 90°, overhead-valve V-8 of 534 cubic inch displacement. It has a very short stroke as compared to its bore: stroke is 4.2 in., bore 4.5 in. It is fitted with special alloy-iron, stress-relieved cylinder heads which bring the compression ratio up to 15.5 to 1. The cylinder heads incorporate two silicon-chrome forged, hard-faced valves per cylinder and Robert Bosch injection nozzles which direct their spray into a pre-combustion chamber in the Hispano Suiza type combustion system. A Robert Bosch fuel injection pump is mounted in the "Vee" between the two banks of cylinders.

The exhaust manifolds are fabricated of corrosion resistant metal and the air-intake manifolds are insulated. Pistons are of aluminum alloy with five chrome-plated rings—three compression rings and two steel segment oil control rings. Both the crankshaft and camshaft have five-bearing support. The crankshaft is of forged alloy steel.

The Ford DV8-534 engine is said by Ford to have "excellent multi-fuel potential." With a "dry" weight of approximately 1350 lbs. (including clutch housing and electrical components) it is rated at 195 bhp at 3000 rpm. The torque curve peaks at 2000 rpm with approximately 387 lbs./ft. of torque at this point.

Reo Diesel A Conversion

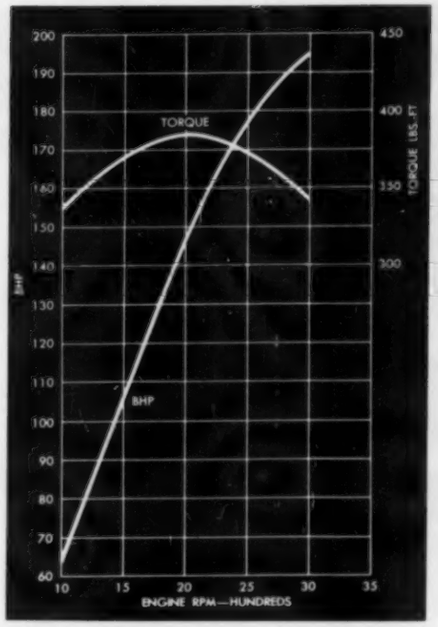
To provide a multi-fuel, diesel cycle engine for this and other military purposes, the Reo Division of the White Motor Co. offers a "beefed up" conversion of their Gold Comet truck engine.

The Reo diesel has a bore of 3⅞ in. and stroke of 4⅛ in.; total displacement, 390 cubic inches. In its present version it has a compression ratio of 16 to 1 but Reo tells us that a 20 to 1 compression ratio engine is being readied as a substitute, and will be placed in medium duty military trucks later.

The Reo diesel is rated at 186 bhp at 3400 rpm and has a maximum torque of approximately 320 lbs./ft. at 2500 rpm. A feature of the engine is its combustion system called the "W" system after its designer, Julius Witsky, director of research at the White Motor Company. The "W" combustion system involves spraying atomized fuel into a precombustion chamber which retains a high degree of heat. The system is said to work very well from the standpoint of tolerating a wide variety of fuels. Since the difficulty in burning gasoline on the diesel cycle seems to be due to a drop in cylinder temperature at low speeds or under low loads, it would seem that any type of precombustion chamber which retains heat would be advantageous in multifuel engines.

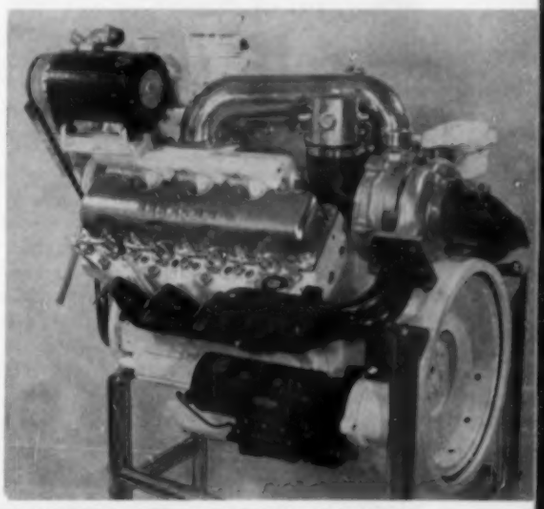
Changes made in the basic Reo Gold Comet block to adapt it to the diesel cycle included "beefing up" the crankshaft, reboring the V8 castings for larger main bearings; new rod and piston designs and slight alteration in the cylinder liner lands.

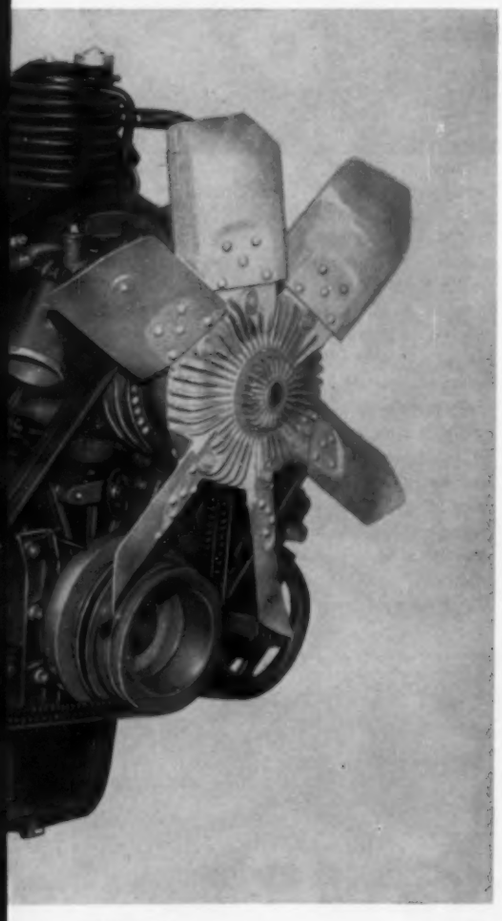
The award of a contract to one or more manufacturers to build 6x6 or 8x8 medium-duty diesel trucks in quantity for the armed forces would seem to be a significant market break-through for the diesel engine industry, especially since this could presage a still broader part in our defense activities for the diesel engine.



Power curves of the Ford Military Diesel.

The Reo Military Diesel Engine, a conversion of Reo's well-known Gold Comet gasoline engine. Present compression of 15.5 to 1 will soon be boosted to 20 to 1.



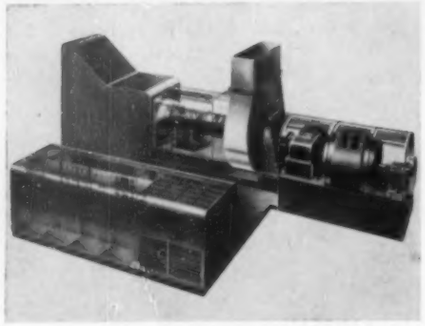


A Reo 8x8 medium tactical truck, one of six pilot models powered by diesel engines and recently delivered to the U. S. Army Ordnance for testing.

GAS TURBINE PROGRESS

A MONTHLY SUPPLEMENT TO DIESEL AND GAS ENGINE PROGRESS REPORTING ON NEW DEVELOPMENTS AND APPLICATIONS IN THE TURBINE POWER FIELD

Packaged Jet Driven Plant



The Cooper-Bessemer Corp., of Mount Vernon, Ohio, has announced development of a completely packaged, jet powered gas turbine plant for gas pipeline transmission and electrical power generation. This self-contained 10,500 hp unit, comprised of the RT-248 jet powered gas turbine and a centrifugal compressor or electric generator, does not require a station housing. The prototype of this unit has been installed at the Clementsville, Ky., pipeline compressor station of the Columbia Gulf Transmission Co. It incorporates an adapted Pratt & Whitney Aircraft J-57 jet engine and a Cooper-Bessemer power turbine. Completely packaged for outdoor service, the new unit does not require a regeneration system, has high cycle efficiency, and operates unattended. Rated power turbine speed is 5000 rpm. The new packaged concept avoids the need for expensive buildings and heavy foundations at the installation site.

Developing 600 HP Turbine

A new 600 hp gas turbine, is currently being developed by Solar Aircraft Co. Solar has received a multi-million dollar contract for a joint Army-Navy development of a turbine which "has design objectives far beyond any small gas turbines now in existence," Herbert Kunzel, Solar president, said. "For Solar, this ranks as the most significant single contract ever received, both in technology required and dollar amount," he added. Among target characteristics for the engine are a long life cycle and fuel consumption well below current industrial gas turbine performance. Among uses seen for the turbine are vehicle and marine propulsion, generator, pump and compressor drives and as an air conditioning power source. It is aimed at filling an across-the-board need for the military and industry. The new 600 hp turbine engine is a completely axial flow regenerative machine with a six-stage compressor, dual rotary regenerators, a single-can combustor, a single-stage gas producer turbine and a single-stage power turbine. The engine will operate at a compressor pressure ratio of 3.8 and have a rotative speed of 21,500 rpm.

Energizer Kit

An energizer kit powered by Solar Aircraft Company's Titan 80 hp gas turbine engine has been ordered by the U.S. Army for testing in a de Havilland YAC-1 Caribou transport aircraft. The kit provides 300 amps of auxiliary electrical power to start the aircraft's twin R2000 radial engines and provide power for certain ground operations when the Caribou's main engines are shut down. The energizer can also be used for cabin heating, giving the aircraft capability for extremely cold Arctic operations. Engine, generator and controls for the energizer kit are packed into slightly less than 4 cu. ft. of space.

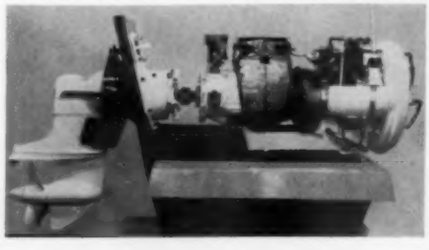
Turbine-Powered Outboard Drive

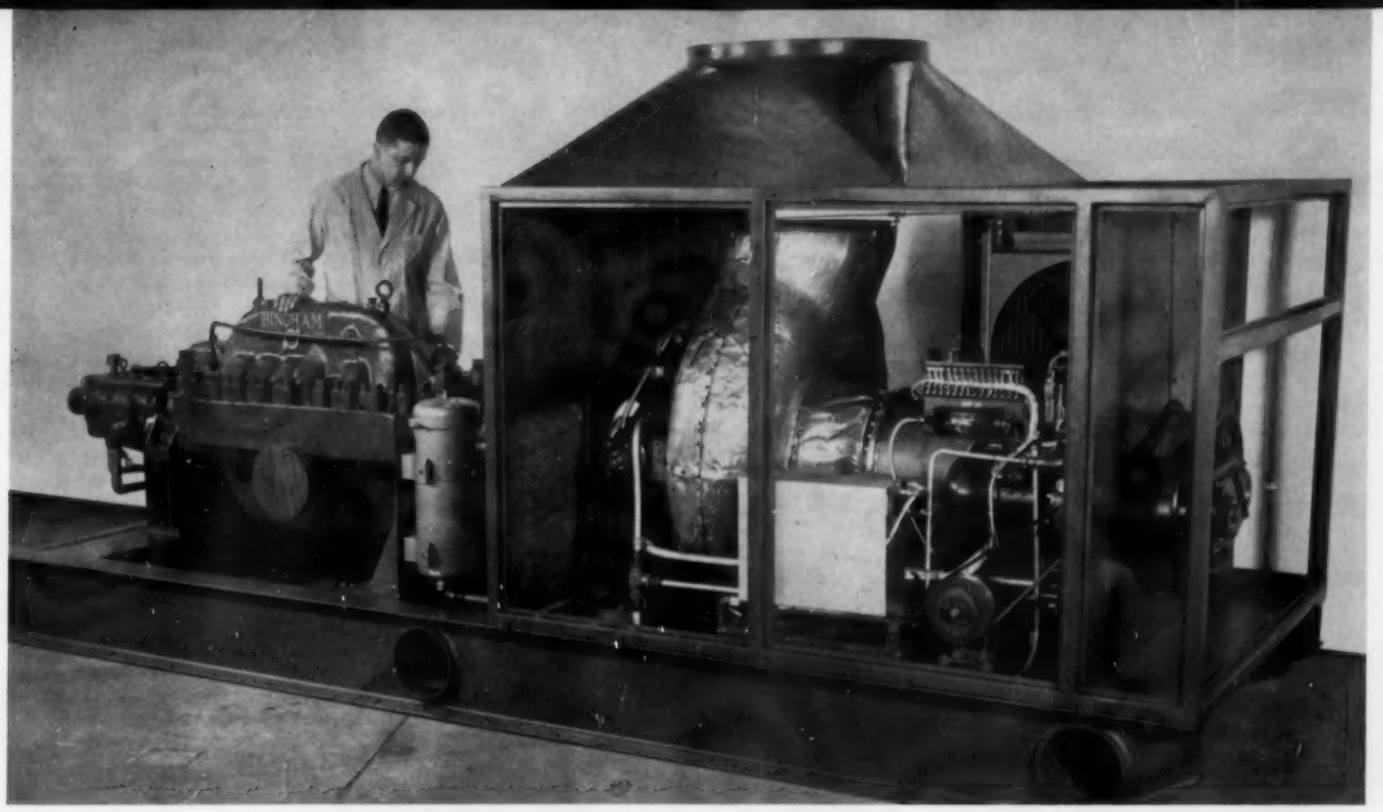
A gas turbine-powered outboard drive was shown recently by the Kiekhaefer Corp., manufacturers of Mercury outboard motors. The engine is Boeing's new Turbo-Mariner, a lightweight, compact turbine developing 260 shp @ 3300 output shaft rpm. The drive is the MerCruiser introduced recently and specially designed to give high-power inboard engines the flexibility, maneuverability and hydrodynamic efficiency previously achieved only by outboard motors. The Turbo-Mariner drives the conventional propeller of the MerCruiser stern drive through reduction gearing. The Turbo-Mariner burns diesel fuel. In production on a limited basis, the turbine, when coupled with the MerCruiser stern drive, (right) permits faster, more flexible and more maneuverable cruisers than possible with conventional inboard installations of the same horsepower.

Governor, Pump Test Stand

First of a new series of Unitest gas turbine governor and fuel pump test stands has been delivered to the Navy by Marine Pumps, Inc. Designed to test and permit calibration of the fuel flow and controls of gas turbine pumps and governor combination, the model U-10000 GT test stand will accommodate a wide range of units. Laboratory accurate data is obtainable on discharge capacity, starting pressure, minimum flow, governor internal leakage, operation of relief valves, idle and high speed control lever settings and acceleration range. Two fuel flow sensing elements are installed in the suction line and one or the other is used depending on range of flow to be checked. For information write Marine Pumps, Inc., division of Diesel Control Corp., Wilmington, Calif.

ITS NEW





Turbine-driven booster pump is currently installed on petroleum pipeline. This two-shaft version of the 1100 hp Saturn powers 6000 rpm pump and is capable of wide variation of flows and pressures because of its variable speed characteristics. Note Winslow oil filter.

SOLAR'S VERSATILE SATURN T-1000

Turbine Engine is Built in Single-Shaft and Two-Shaft Versions. 1100 HP Unit Currently Used for Generator, Compressor and Pump Applications in Several Fields

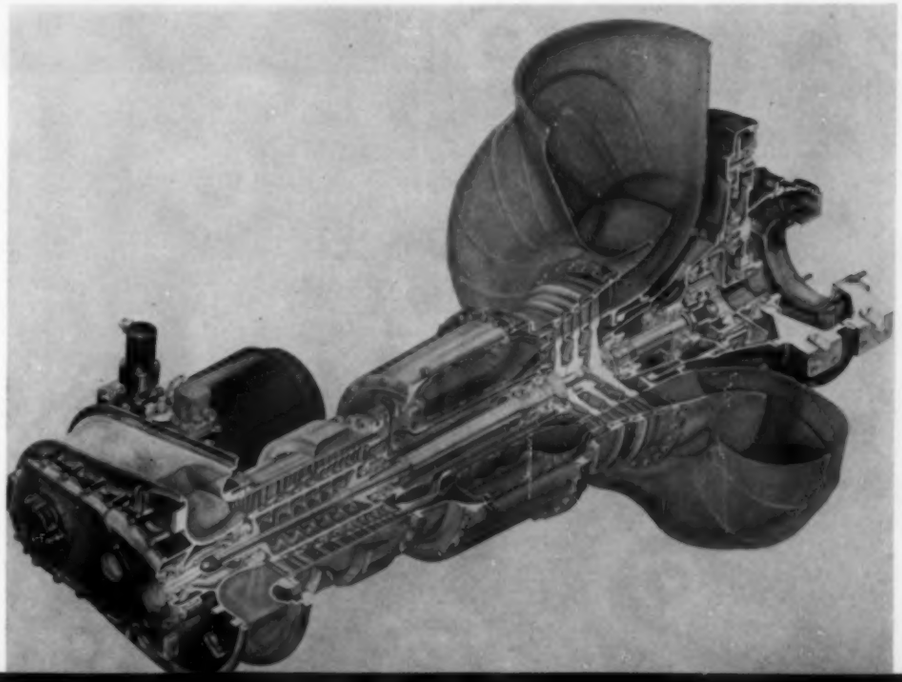
AMONG the more interesting stories of the past year in the prime mover field has been the upsurge in application of the small horsepower gas turbine to industry.

One of the leaders in this area has been the 1100 hp Saturn T-1000 gas turbine engine built by Solar Aircraft Co. of San Diego, Calif., a subsidiary of International Harvester Co. The Saturn engine is currently being used in a variety of generator, compressor and pump drive applications, primarily in the oil and gas industry.

The reason for the seemingly sudden burst in the case of the Saturn T-1000, according to O. M. Sievert, Solar's manager of turbomachinery sales, is that the engine combines turbine advantages of light weight, compactness, easy starting, versatility and simplified maintenance with excellent simple cycle fuel consumption and long-life design.

The Saturn engine, which went into production last June, consists of an eight-stage axial flow compressor, annular type combustor and three-stage axial flow turbine with a reduction gearbox driven from the turbine end. It is available in both single shaft constant speed and split shaft variable speed versions.

The Saturn has an engine control system which provides automatic starting and easy load regulation. This system includes a complete engine monitoring system with start-stop switch, hour meter, start counter, tachometer, oil pressure gauges, starting sequence relays, circuit breakers and warning lights for low oil pressure, high oil tem-



Cutaway drawing of Saturn T-1000.

perature, incomplete starting sequence, exhaust gas overtemperature and turbine pressure.

Speed of the gas generator turbine is 22,300 rpm. Output speeds varying from 1200 to 1800 rpm are transmitted from the turbine through a two-stage reduction gearbox which effects a primary reduction to 6000 rpm and a secondary reduction to the selected ratio. Compressor pressure ratio is 6.6:1. Exhaust air temperature is 1500° F. at maximum output and 1400° F. at continuous output. Accessories are driven from the primary gear and also from a spur gear at the front of the engine and connected to the main shaft through a splined quill shaft. The main reduction gear is the spur planetary type with a spur and zerol bevel accessory drive. The fuel system is automatic and includes fuel governor, acceleration control, fuel pump and/or pressure regulating equipment. Ignition system is also automatic. The starter-generator is a 500 amp, 24 volt, dc generator with starter winding. No external cooling of the engine is required.

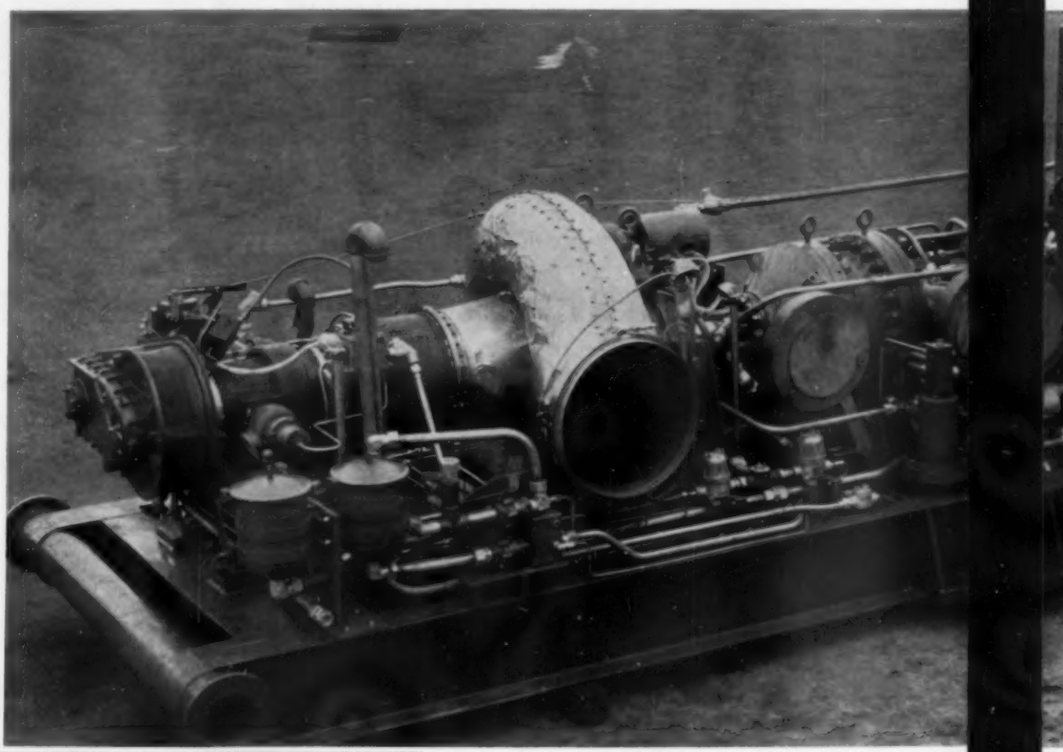
Fuel consumption is 0.63 lbs./hp/hr. on liquid fuel such as diesel or 11,500 Btu/hp/hr. on natural gas. Design life is 100,000 hrs. with an overhaul interval of 8,000 hrs. The engine weighs 1250 lbs., including reduction gear, and is 70 in. long, 45 in. wide and 44 in. high.

The Saturn is being utilized in a variety of current applications, all of which take advantage of the turbine's unique characteristics. The Western Co., prominent oil well servicing experts, is using the Saturn engine to drive its new RB-100 triplex pump for oil well fracturing operations. (See story on page 43.) The torque multiplication characteristic of the two-shaft version of the Saturn turbine is important in delivering pressures at the crucial moment. The two-shaft Saturn engine is well suited for variable speed applications of this type since it has the torque speed characteristics of a built-in torque converter. It can be used, therefore, where torque multiplications are desired without adding an additional torque converter with accompanying power losses and cost.

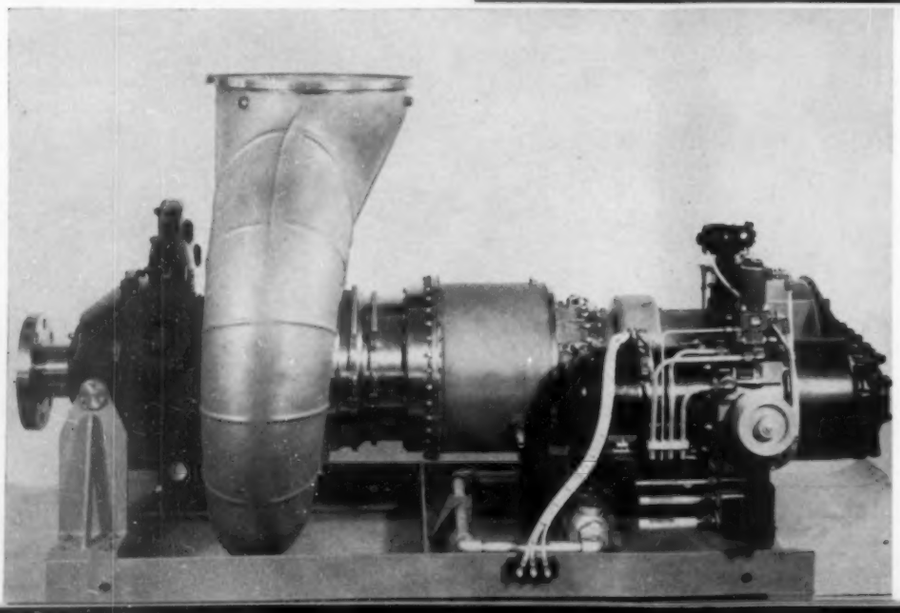
This variable speed advantage is also evident in a Saturn-engine-powered pipeline pump currently being installed by Okan Pipeline Co. It allows the 6,000 rpm high pressure pump to deliver a wide variation in flows and pressures. The turbine burns liquid butane, taken directly from the line and stored at the site. It is also capable of burning other refined liquid fuels. Saturn-powered pumps will soon begin operation in oil well water flooding operations.

A single-shaft version of the Saturn engine is also available for constant speed applications where close speed regulation is desired. The high rotational inertia of the rotor and the instantaneous response of the combustion system permit large sudden load changes with very small variations in speed. One of the most promising uses of this constant speed Saturn turbine is in generator sets. A typical current application is in a petroleum plant where three turbines drive three 800 kw, 60 cycle generators turning at 1,200 rpm. These Saturn engines run on natural gas.

Another turbine feature makes itself evident in this application. The most common cost index used to compare the merits of one prime mover with another is fuel consumption. On this basis alone, the gas turbine has always been at a disadvantage because its thermal efficiency is excelled by many of the commonly used prime movers today. However, there are other benefits that can be realized by taking advantage of unique turbine qualities. Because the turbine does not need a cooling water system, virtually all of the unused heat is rejected in the exhaust, yielding a large volume of hot but clean air. In this petroleum plant, the Saturn turbine's waste heat, approximately 8,000 to 10,000 Btu/hp/hr. is used to generate steam for plant processes and thus gives a very high thermal efficiency in this application.

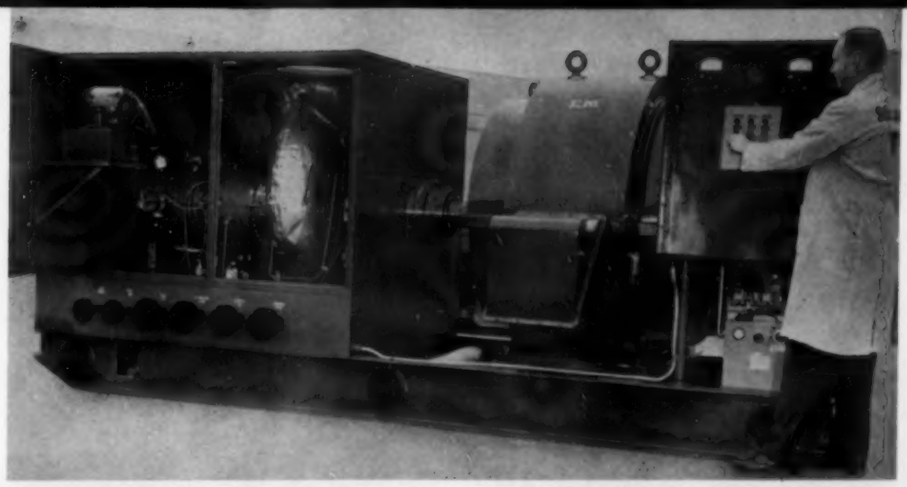


Compressor set consisting of Saturn gas turbine driver and specially designed Solar centrifugal compressor. Self-contained package weighs 10,000 lbs., is 16 ft. long.



The 1100 hp Saturn gas turbine engine weighs 1250 lbs., occupies under 51 cu. ft. of space and has specific fuel consumption of 0.63 lbs./hp/hr.

Although the Saturn turbine has a relatively conservative turbine rotating speed of 22,300 rpm, high speed is often cited as one of its disadvantages. However, the availability of a high-speed driver releases the equipment designer from traditional low speeds and makes it possible to use direct-connected driven equipment with resultant savings in size and cost in many instances. A case in point is the new industrial compressor developed by Solar to take advantage of the rotating speeds of the turbine drivers. It is a centrifugal with multi-staging to accommodate changing flow



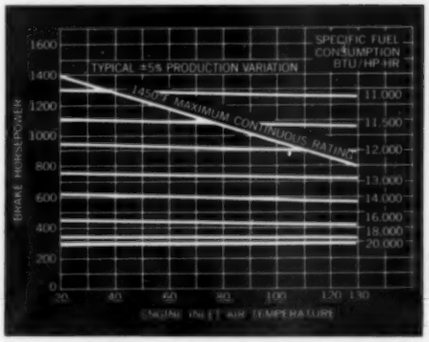
This 800 kw turbine-generator set weighs 19,500 lbs., drives Electric Machinery Co., generator. Exhaust heat is utilized to produce steam for processing operations. Another variation would utilize waste heat for heating and absorption air conditioning.

and pressure requirements. Currently, engine compressor sets have been ordered by Trunkline Gas Co., United Fuel Gas Co., and Tennessee Gas Pipeline Co. A typical set is a completely self-contained package weighing only 10,000 lbs. and measuring 16 ft. in length. Light weight allows it to be mounted on a relatively small skid. In each of its current applications, the turbine will use natural gas fuel directly from the adjoining line.

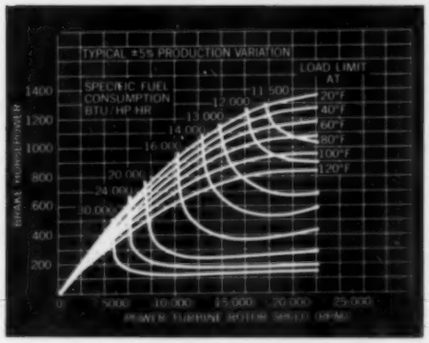
The compressor is a modular design that can be assembled in from one to eight stages depending on the desired flow and pressure ratio. It can handle flow rates from 5 to 150 million scfd at discharge pressures up to 1500 psi at efficiencies

up to 75 per cent. Modular construction allows changing of compressor components in the field to accommodate changing pressures and flows. This is accomplished by a "family" of interchangeable compressor wheels installable in the field.

At present, Solar is developing two new engines with the same conservative industrial design considerations included in the Saturn engine, according to Sievert. One, the 350 hp T-150 turbine, will, among other applications, extend economies and thinking in the area of complete utilization of heat for power generation and air conditioning. The other, a new 600 hp engine with a specific fuel consumption objective of 0.40 lbs./hp/hr., should expand turbine applications to a number of new areas where they are now considered unfeasible, Sievert says.



Performance chart for single shaft, constant speed Saturn T-1000 turbine. Engine speed is 22,300 rpm.



Performance chart for two-shaft Saturn turbine. Fuel curves are for ambient temperatures between 20°-120° F.

Western's Turbine-Driven Fracturing Pump

The techniques of hydraulically fracturing oil and gas wells to increase productivity is one of the mainstays of the oil industry. This technique consists of pumping fluids containing sand into the formation rock. The fluid causes the rock to rupture, or fracture, due to hydraulic pressure. This fracture is then kept propped open by the sand, thus permitting free flow of the oil or gas to the well bore for production.

The increase in the production of the well is directly related to the area of fracture created. In turn, the fracture area created is directly related to the rate at which the fluid is injected. Therefore, there has been a steady increase in the demand for higher injection rates. This demand has required that high horsepower be made available at the well site to power the pumps.

To meet this demand The Western Co., an oilfield service firm, designed and built the "Jet Fracmaster 1200." (See Cover) The starting point in the design of the unit was the selection of the prime mover. The Solar Saturn turbine was chosen. The transmission and pump were then designed to match the characteristics of the turbine.

The Saturn drives the RB-100 pump through a four-speed transmission built by Western Gear Corp., Southwestern Division. It was necessary to design the entire transmission to meet the high load, low weight requirements. This four-speed transmission includes some special features to meet the requirements. In the high speed position only one gear mesh is used. The bearings are arranged to minimize the number of high-speed bearings required, thus reducing the lubrication requirements. The input and output shafts are in line with opposite rotation. To aid in shifting the transmission a braking device is automatically applied to the gears when the clutch is disengaged.

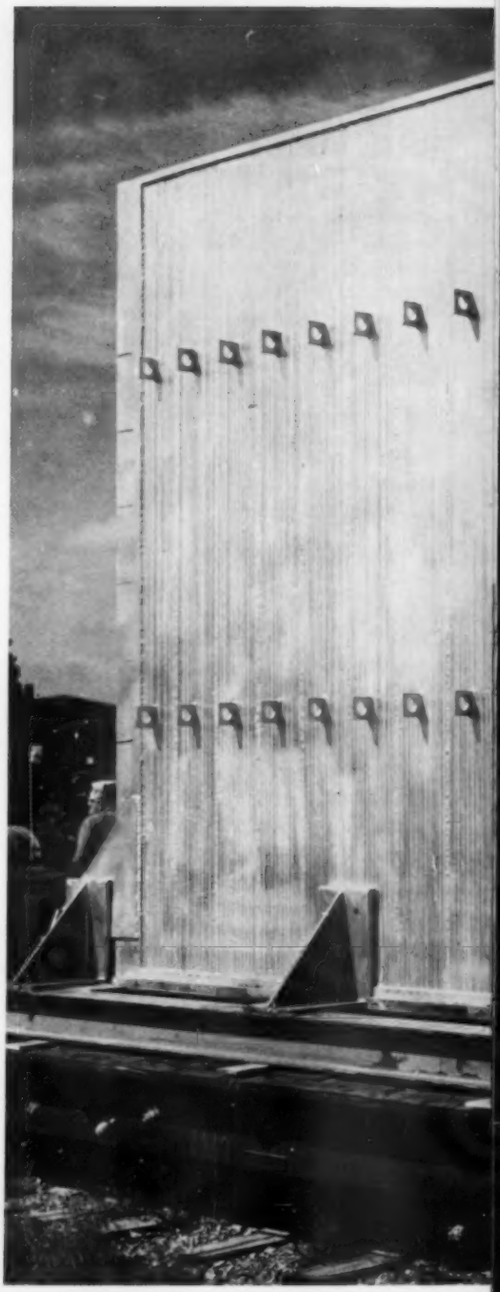
The RB-100 pump was built in The Western Company's own manufacturing shop. It was patterned after the smaller RB-80 pump, which had proved itself in the industry since its introduction six years ago. At fourteen critical bearing surfaces in the pump, Torrington roller bearings are used. This use of roller bearings permits the use of large bore pistons in the pump, with the consequent high crankshaft load. The bearings also permit the pump to be run at high rpm's. The end result—high fluid displacement capability at low pressures—plus the ability to handle the high horsepower at pump pressures up to 6000 psi.

Four years of research and development went into the development of the matching components for the Jet Fracmaster 1200 and they have resulted in a highly efficient unit. It delivers 1000 hydraulic horsepower in all pressure ranges yet weighs only 23,000 lbs.

TURBINE REGENERATOR DESIGN CONSIDERATIONS

A Condensation of a Paper Delivered at the ASME Gas Turbine Power Conference Reviews General Specifications and Design Restrictions From Manufacturing Viewpoint

By R. F. CAUGHILL*



THE gas turbine regenerator or recuperator is a heat exchanger used to improve specific fuel consumption by the recovery of energy from the waste heat in the exhaust gases. This has been an important topic of discussion ever since the turbine has been considered as a source of power. It is our intent to review briefly some of the design specifications of the regenerator, and to give some history of the Harrison activity in this field.

In the mid-forties plate-fin designs were constructed using Inconel as the base material. In these early instances the gas temperatures were in the 1100° F region, consequently, high temperature alloys were definitely required. From this time to 1955 research activities continued but no commercial activity was undertaken. It was not until 1956 that another serious look at regenerator applications occurred. Here temperature demands for industrial gas turbine application were lowered to approximately 950° F, consequently, carbon steels, copper brazed, were definitely considered feasible for this use.

At the start, specifications had fixed end points as far as effectiveness and total pressure loss were concerned. Point A on the chart Cycle Efficiency versus Pressure Drop, Figure 1, represents the original design point of 4 per cent total pressure loss and 80 per cent air effectiveness. Later more flexibility was allowed which can best be explained by the shaded area of the chart. Any point in the shaded area represents a regenerator superior in performance to design point A. For example, a regenerator having its performance at 78 per cent effectiveness and 3.0 total pressure drop, point B, results in an improved overall cycle efficiency of the gas turbine compared to one represented by point A.

There is a mutual advantage in allowing the regenerator designer the latitude of design as shown by the shaded area. The manufacturer can then use his facilities for the best possible economy. He can adjust the size to conform to such things as furnace capacity, equipment availability, and shipping restrictions as well as adjust the overall dimensions to the best advantage of the buyer.

At the start of the theoretical design exploratory calculations were made using existing basic heat transfer and friction factor data. Following this paper study, other basic data cores were constructed, tested, and analyzed. After completing the entire investigation, we could pick from over 500 different designs—a choice only made possible by programming on electronic computer equipment. Besides heat transfer and thermodynamic aspects of the design, close consideration for structural soundness was required. Consequently, oxidation test samples of mild steel plates and fins brazed together with copper were subjected to a temperature of 900° F in an air circulating furnace. Under these conditions the exposed copper of the brazed joint was attacked rapidly, losing 10 per

Assistant Chief Engineer, Harrison Radiator Division, General Motors Corp., Lockport, N.Y.

Figure 1—Regenerator design—cycle efficiency versus pressure drop.

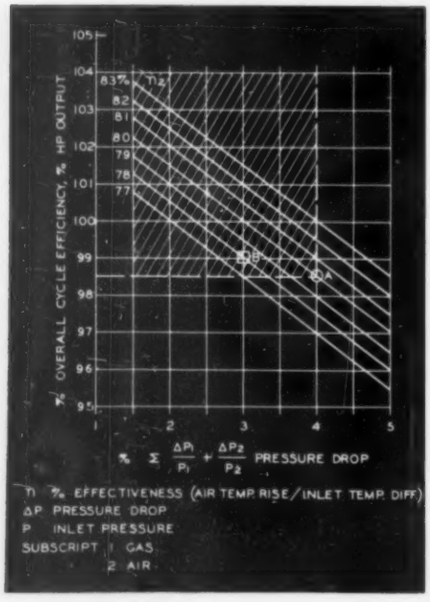
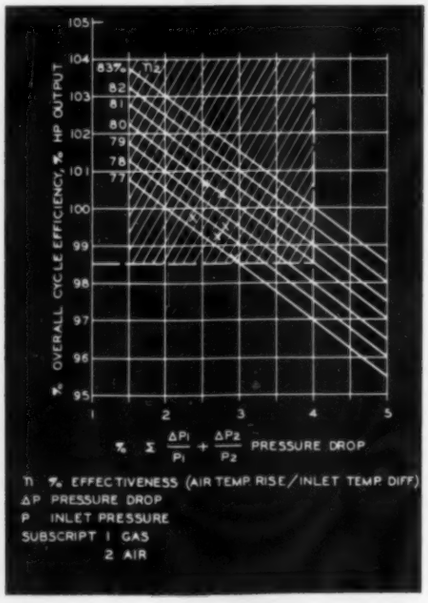
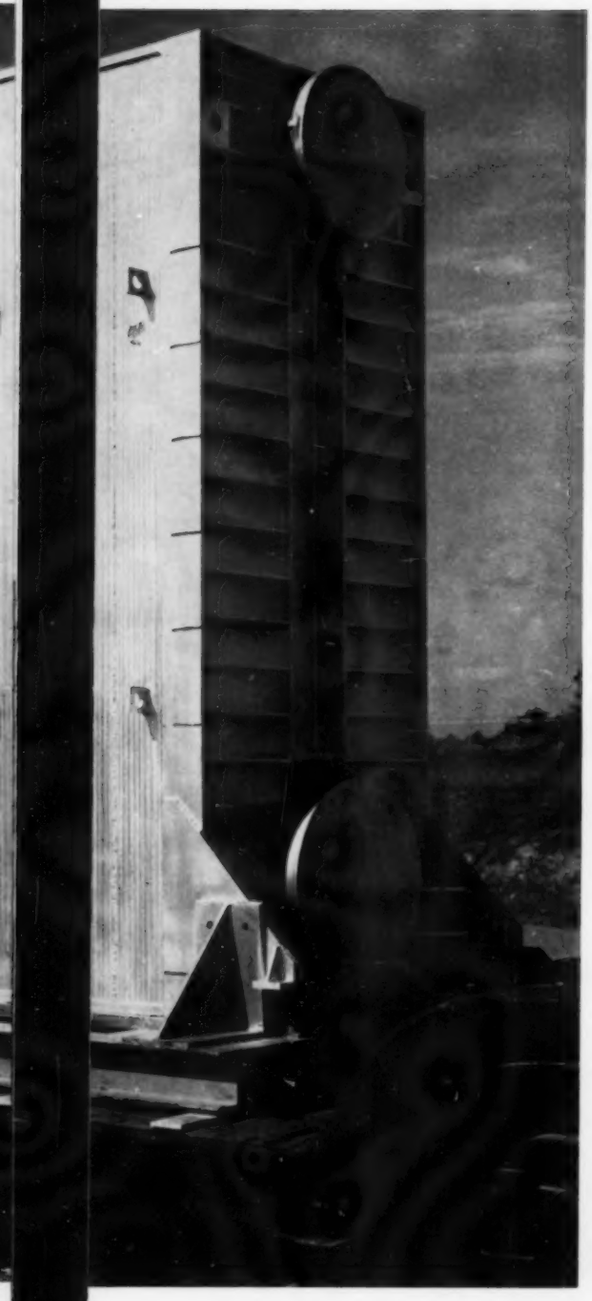


Figure 2—Regenerator design—cycle efficiency versus pressure drop.





Part of regenerator assembly prior to shipment. Air from compressor enters top flange, picks up heat and returns to combustion chamber through duct connected to lower flange.

cent of its bond after 5000 hrs. However, a gray material formed over the copper which then acted as a protective shield. Microscopic examination revealed that continued exposure even up to 26,000 hrs. caused no change in the amount lost. The steel likewise formed its protective oxide coating and only one per cent of the base metal was found to have been lost.

Operating experience, or more specifically, test experience came shortly after the first turbine regenerator was delivered to the site at Alexandria, La. Here, through the excellent cooperation of the General Electric Company and Tennessee Gas Transmission Co., pressure taps and thermocouple probes were installed in the duct work leading to and exiting from the regenerator. The results of testing were most satisfactory and proved that the performance of the regenerator was equivalent to the desig.n goal.

These results, marked X in Figure 2, establish the overall cycle efficiency at a level greater than that required by the original specification, with the air side effectiveness ranging from 77 per cent to 80 per cent and the total pressure drop from 2.3 per cent to 2.9 per cent.

An accompanying illustration shows a view of Texas Eastern's Owensville, Ky. station where two Harrison regenerators shown in the foreground are located. To get a better idea of the regenerator without insulation, the picture at top center shows one-half the assembly mounted on railroad car prior to shipment. Air from the compressor enters the top flange shown in this view, picks up heat, and returns to the combustion chamber through duct work connected to the lower flange. Hot exhaust gas from the turbine flows in a countercurrent direction, entering at the bottom face of the regenerator and exiting at the top. During the early part of November 1960, personnel of Texas Eastern Transmission Co. were kind enough to let us examine one of the regenerators which had been in operation for two years. The air side ducts were not removed but a thorough examination was made on the gas inlet and outlet faces, pictures were taken, and deposits on the gas fin and on the floor of the inlet gas duct were collected. Welds were examined and the general condition of the unit was noted.

The general appearance was very good. Visible surfaces showed a general reddish cast interspersed with gray-black areas. Analysis of the deposits from scraping the gas fin disclosed magnetic oxide Fe_3O_4, black in color, forming next to the metal and over this a thin film of red oxide, Fe_2O_3.

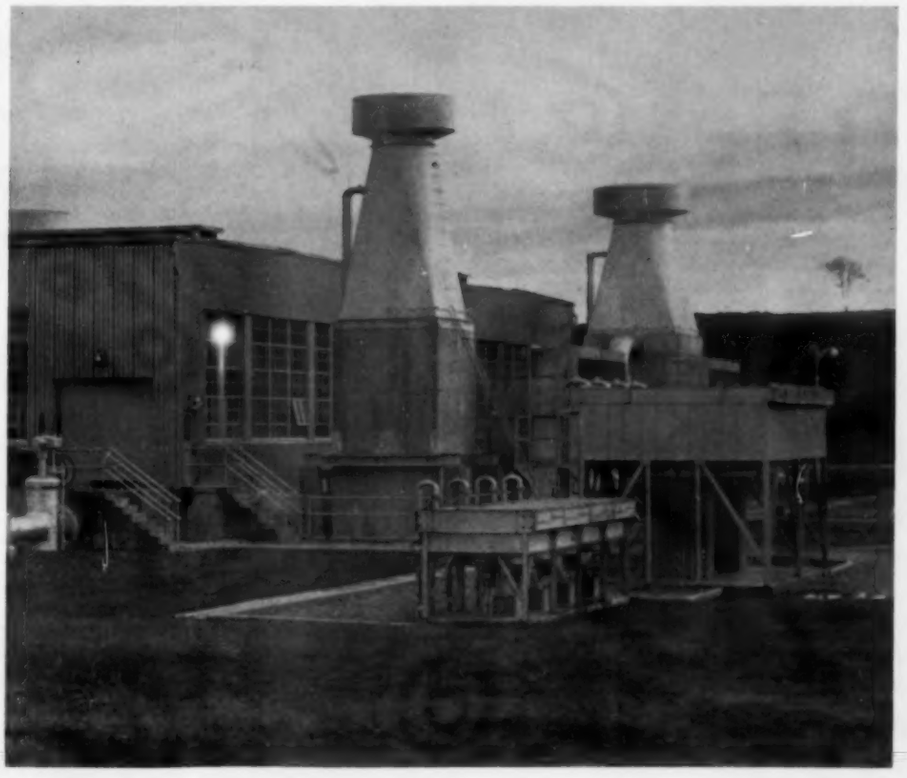
The loss in fin thickness over this two year time period corresponds very closely to the amount lost in laboratory oxidation tests at 900° F. This indicates that the hard, tenacious scale which we found next to the base metal builds up a protective layer that prevents rapid corrosion under continued operating use.

Comparing that which we know from oxidation tests to that learned after two year's field experience, we believe that the 15 year design expectancy will be met. Furthermore, fouling does not appear to be a major problem. It is doubtful that the gas fins will require cleaning under similar service conditions. It was interesting to note that the station log recorded approximately 125 starts and stops and that temperature recordings gave no indication that performance was diminishing during this two year period.

For the immediate future it appears that regenerators similar to this one will be in demand. Some flexibility is inherent in the basic design, depending upon the type of installation desired. Changes in fin configuration can be made to reduce size and weight as increased use of regenerators permit refinements in design.

At some point rotary or more compact surfaces may show definite advantages. We at Harrison are working on both designs and have produced rotaries in small quantities which are now in use.

Owensville, Ky., station of Texas Eastern is served by two Harrison regenerators.



COSTS CUT WITH NEW POWER TOOLS

MAINTENANCE of engines and equipment can be a large cost factor in any operation and it follows that tools which speed maintenance will cut the cost of operations. Over and above labor savings realized by tools which allow a mechanic to perform a particular job quicker, the tool usually increases employee morale when the mechanic finds he can do the job quicker and better without knuckle busting.

This was the experience of Western Machinery & GMC Truck Co., of St. Louis, Mo. The company recently added 27 electric power wrenches for their service shops and have learned that the tools not only promise to give maximum return on their investment but that the men who use them are pleased with results too.

Western Machinery is an aggressive, 31 year old company with varied, far-flung activities. As a GMC truck dealer it serves greater St. Louis. A separate entity markets General Motors diesel engines in Missouri and Illinois. The company also builds underground mine trucks sold throughout the world. Operations in the St. Louis area alone grossed more than $4 million last year.

The company maintains a large, well equipped shop staffed by more than 40 mechanics. When service department executives decided to equip the men with electric impact wrenches the selection was made after testing various makes in the shop under working conditions and noting the mechanic's preferences. The 27 wrench order consisted of Ingersoll-Rand Impactools, 25 with ½ in. square drive and two with ⅝ in. square drive. Service Manager Pete Krietemeyer reports that an overall increase of 5 per cent in shop output could be credited to the new power wrenches. With total volume near $300,000 a year, this means an increase of $15,000, a rate of gain sufficient to pay for all the tools in the first three months. The other objectives also were achieved—improving service to customers and reducing the mechanics' sweat and strain.

Using the power wrench to remove a transmission rear bearing cap. Mechanic finds use of this power tool save him from 1 to 2 hrs. in disassembly and reassembly of a Fuller RoadRanger transmission.

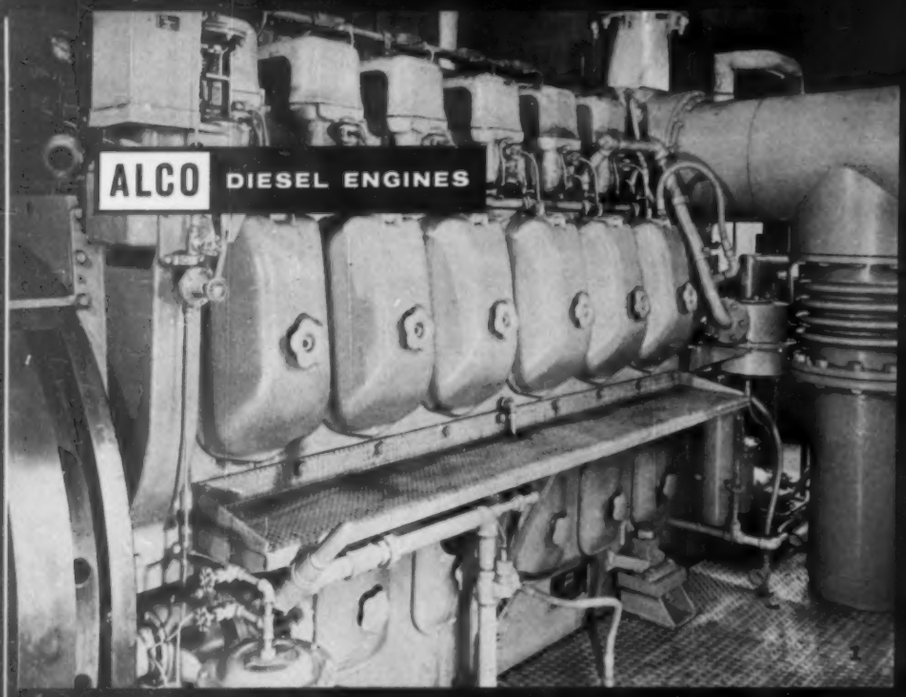
Mechanic uses an Ingersoll-Rand 5UT electric Impactool to run main bearing nuts. He reports he can tear down a GM diesel in 6 hours, compared with 8 hours with hand wrenches.

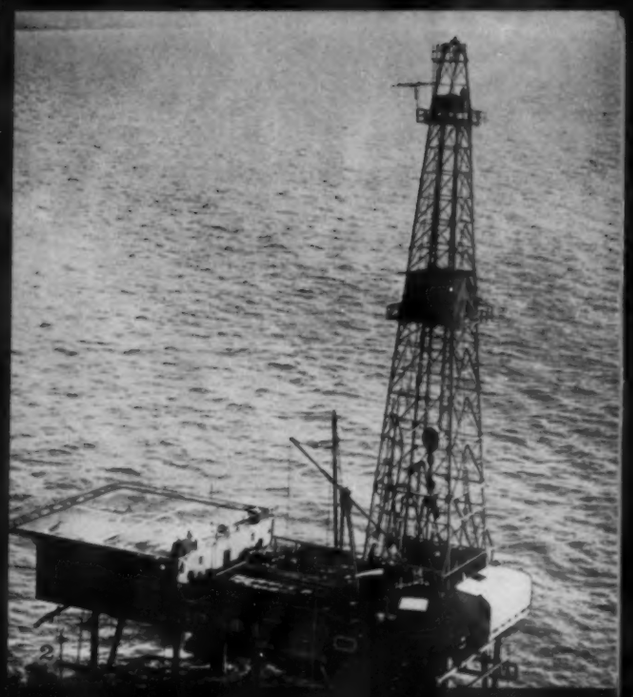
The smaller power wrench is most used on brake, engine, and transmission jobs. One engine man reports that he can tear down a GM diesel in six hours with the power tool compared with eight hours with hand wrenches. On reassembly, he says the ⅜ in. and $\frac{7}{16}$ in. bolts "go in easy." He also saves time on nuts and bolts larger than the tool's rated capacity. For example, in tightening 14 head nuts to a torque of 180 ft. lbs., he first runs the nuts down with the Impactool, then finishes up with a hand torque wrench. Total time is just 5 minutes compared to 15 or 20 minutes with the hand wrench alone. A transmission mechanic says he saves at least one hour and sometimes as much as two hours in disassembly and reassembly of a Fuller RoadRanger transmission. Many nuts come off hard all the way, he explains, and the power tool not only speeds the job but "makes the work so much easier." The wrench can be used as a straight impact wrench or fitted with torsion bars which shut the tool off automatically at torque settings from 20 to 90 ft. lbs.

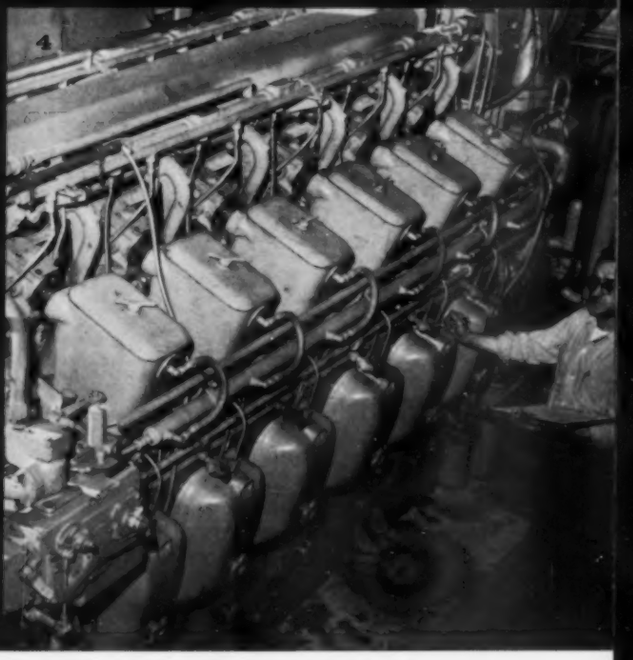
The ⅝ in. drive wrenches are used primarily for axle and spring jobs. Tightening U-bolts used to be a tough, knuckle-busting job. The power tool makes it easy and cuts time on a pair of front springs from half an hour to 10 minutes. Axle flange nuts can be removed or replaced in 5 minutes compared with 10 to 15. The wrench can also be used on such jobs as tightening truck bumper studs, fifth wheel supports, drive shaft supports, and many more.

When the electric tools were put into service, the truck department and the engine department shared the same shop and drew tools from the same crib. Recently, the engine sales and service department became an autonomous unit and moved to its own building, taking six of the ½ in. drive Impactools along. This report covers primarily the truck department's use of the tools but it is evident that the mechanics who work on industrial engines find them just as useful.

Portion of the Western Machinery truck service department where 40 mechanics handle a $300,000 volume.







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2. Three 251's power a large offshore drilling platform. The operator reports that fuel consumption is much lower than competitive engines, while the 251's controllability allows him to speed up costly drilling operations.

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AP 130

Menasha Plywood Division of Menasha Wooden Ware Corp., has equipped five of its Mack logging tractors at North Bend, Ore., with Lear electric retarders. Average trailer load is 16,000 bd. ft., of logs for gcw averaging 150,000 lbs. Much of trucking is downgrade at 20 mph with max. grades of 17 per cent and average grades of 8 per cent.

SPEED RETARDER UTILIZES EDDY CURRENT PRINCIPLE

THE need to assist conventional brakes or heavy vehicles on long downgrades has long been recognized. Numerous tests have shown that conventional service brakes seldom have sufficient drum or lining dimensions to assure adequate dissipation of heat in cases of prolonged braking. Even on normal profile roads, repeated brakings often create enough heat to dangerously reduce braking efficiency. To help ease this problem various manufacturers are producing a number of retarding devices to handle braking on grades and in traffic to reduce load on the service brakes.

A new entry into the vehicle retarder market in this country is a product well known in France and recently introduced in the U.S. by Lear Incorporated's Electro-Mechanical Division of Grand Rapids, Mich. Exclusive sales rights and option to manufacture the electrical braking device for trucks, trailers and school and commercial buses have been granted to Lear by the French manufacturer, Telma, of Paris. The retarder, used successfully in France for more than 10 years, is mounted in the drive shaft, permanently geared to the rear wheels, and requires only the battery for excitation. The vehicle's own energy is used to retard its motion. Available in four models for vehicles up to 35 tons gcw the retarder operates on 12 and 24 volt systems.

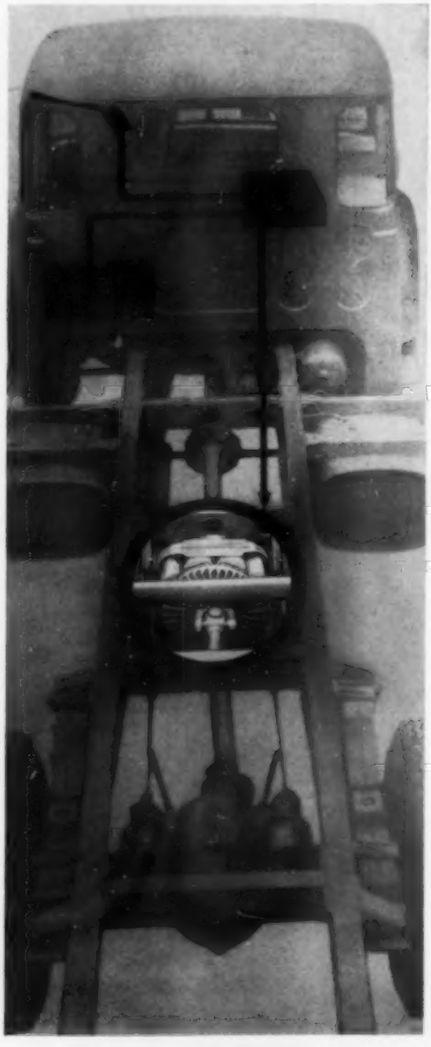
The Lear retarder operates on the eddy current principle. The device contains two main elements —a stator which is fixed to the vehicle's chassis, and a rotor which is driven, usually by the vehicle's drive shaft. There is no physical contact between these elements.

The stator consists of a series of electromagnets energized by the vehicle's electrical system. Excitation of these coils is controlled by a four-position handle mounted on the steering post. Current path is from the battery, through a control box, to the coils and back through the vehicle's ground.

The rotor consists of two steel discs which are rotated by the drive shaft or other drive train accessories. Electrical eddy currents produced in these discs while rotating in the stator's magnetic field create the retarding action. The heat thus generated by conversion of the energy of motion is rapidly dissipated to the surrounding atmosphere by specially designed fins cast into the discs. The four-position handle provides successive excitation of four different circuits to give the desired degree of braking. Maximum retarding force can be produced in two or three seconds with either the 12 or 24 volt models. Official tests conducted in France showed that the Lear retarder will consistently stabilize speed of a 14 ton truck at 22 mph on a 14 per cent down grade. Other tests with heavy vehicles on steep grades showed that action of the retarder alone provides a deceleration from 47 mph to 6 mph within a distance of under 220 yds.

The retarder cannot be disconnected from the braked wheels and it can be used with the clutch engaged or disengaged and with the engine completely stopped. Mechanical failure within the vehicle or careless handling cannot cause failure.

Since the retarder alone can handle almost all braking actions not requiring a full stop it follows that service brake wear and tire wear due to grabbing is significantly reduced. Other benefits in terms of shorter trip times and driver comfort are also indicated.



Retarder is installed in the driveshaft between transmission and the rear axle. Complete system consists of control handle in cab, control box and retarder assembly. System operates off current from battery.

AiResearch Program Manager

J. T. Shore

Appointment of James T. Shore to the newly created post of program manager for industrial gas turbines has been announced by Garrett Corporation's AiResearch Manufacturing Division, Phoenix. Mr. Shore has been serving as sales engineer in Garrett's Fort Worth office since 1959. As program manager he will have management responsibility for the industrial applications of AiResearch gas turbines and related products. In his announcement creating the new post, J. J. O'Brien, division manager pointed out that AiResearch intends to place greater emphasis on industrial applications for its small gas turbines.

Automatic Fill Valve for Lubricator

The Lubricator Division of McCord Corp., announces the availability of the new A 30700 automatic fill valve for force feed lubricators. The valve keeps oil reservoirs filled automatically. It is used for automation of gas engines and compressors, eliminating the need of manually filling the lubricator reservoir. This simple and effective design is readily fitted to existing lubricators by top mounting with two screws. It prevents lubricator from running dry and extends time period for checking oil supply on the force feed lubricator. It is made of steel with ball check valve that lifts from its seat by the action of unicellular foam rubber float. It is also available with grounding terminal to shut down gas engine by grounding magnetos. For more information contact John T. Davis, McCord Corp., East Grand Blvd. at Piopelle, Detroit 11, Mich. (ITS NEW)

Detroit Diesel Appointments

The Detroit Diesel Engine Division of General Motors has appointed Kenneth L. Hulsing assistant director of engineering. Mr. Hulsing joined Detroit Diesel in 1942 as an analyst in advanced engine design. Prior to his present appointment he was staff engineer in charge of product design.

K. L. Hulsing

C. E. Ervin

C. E. Ervin has been appointed to Mr. Hulsing's former post. Mr. Ervin joined Detroit Diesel as an experimental laboratory assistant in 1940. He was chief project engineer prior to his present appointment.

West Coast News

By **James Joseph**

PURCHASED: by Navajo Freight Lines, Inc., Denver, 84 DCO-450 International-Harvester tractors powered by Detroit 71 series diesels.

TO Rock Transport Co., Redding, Calif., a Caterpillar model 1673 truck engine. Sale by Peterson Tractor Co., San Leandro, Calif.

FOR the motor vessel *Frostland,* an Allis Chalmers DATMR 1125 marine diesel. Sale by Seattle's Pacific Marine Supply Co.

NAT MacDougal Corp. has taken delivery of a model 1250 Lima shovel powered by an Allis-Chalmers 21000 series engine (340 hp at 2000 rpm) with 16:1 Clark converter, for construction job on Ice Harbor Dam project.

SOLD: to Andrews Equipment Service, Spokane, three 125 kw Allis-Chalmers diesel generators and one 200 kw Allis-Chalmers generator set.

INSTALLED: in the motor vessel *Discoverer,* owned by Ketchikan Transportation Co., a Lister-Blackstone HA3 (air cooled) driving hydraulic pumps and a 10 kw, 115 volt generator.

FOR the fishing vessel *Lucky Star,* of Seattle, a model SL3 Lister-Blackstone driving a 2 kw, 32-volt generator and a 4x5 in. water pump, used in live crab fishing. Sale by Marine Equipment Co., Inc., Seattle.

TO Collins Electrical Co., Stockton, Calif. for Monterey Hospital, Ltd., a turbocharged (and aftercooled) Caterpillar D333, driving 125 kw generator.

WEBB Construction Co., Salem, Ore., has taken delivery of an Allis-Chalmers 125 kw generator set mounted on a trailer with self-sustained fuel tanks.

FOR the 70 ft. halibut schooner *Celtic,* operating from Seattle, a model SL2 air cooled Lister-Blackstone driving a 30-volt generator, reefer compressor.

ANOTHER Lister—an SL3—has been installed aboard the motor vessel *Sea Star,* driving a 4x5 in. water pump for live crab tanks. Sale by Marine Equipment Co., Inc., Seattle.

TO Koehring of California, Stockton, a Caterpillar turbocharged D333 (150 hp at 2200 rpm).

RICHLAND Tug & Barge Co., operating in the Pacific Northwest, has taken delivery of an Allis-Chalmers DAMR 1125.

ANOTHER Allis-Chalmers DAMR 1125 has been installed in the motor vessel *Washington.*

FOR the yet unnamed 65 ft. offshore cruiser abuilding in San Pedro, Calif's F&T Boat Works for Jerry Altfelich, Los Angeles, a Caterpillar D342 turbo main propulsion diesel (220 hp at 1200 rpm) and for auxiliary power aboard, a D311 (70 hp). Sale by Shepherd Machinery Co.

DELIVERED: to Fluor Corp. for use on Peru construction job, two Caterpillar D353 (175 kw at 1200 rpm) diesel sets with Electric Machinery generators.

POWERING pumps on an Artesia, Calif. flood control project are two U-501 Continental Red-Seal natural gas engines (2070 rpm, 106-hp), purchased by Emblem Homes Inc. Sale by Industrial Engine Service, Los Angeles.

TO San Antonio Water Co., California, a natural gas fueled S820 Continental engine (150 hp at 1800 rpm) for water pump service.

O-P Diesel Brochure

A new brochure, "Mariners: Opposed Piston Diesel Power," describes the Fairbanks-Morse 38D8⅛ opposed piston marine diesel. It includes cutaway drawings showing outstanding features, cycle of operations, and the fuel, scavenging, air starting and exhaust systems. Sketches show how the phase changer works. A table lists ratings and principal dimensions. For a copy, write S. K. Howard, Diesel Division, Fairbanks, Morse & Co., Beloit, Wis. ITS NEW

Special Hauls Featured

Featured in Fuller Manufacturing Company's magazine, *Transmission Topics*, is a trucking company that has come up with some really new ideas on special trailers to haul liquids one way, and commodities on the return. Also spotlighted are a construction job which calls for moving 2½ million yards on three highway interchanges, and a specially designed school bus for handicapped children. "Pineapple Harvest in the Islands" provides a special feature, while Part II of the Schuler "The Proper Installation and Maintenance of Trailer Axle Assemblies" and a schedule of Motor Fleet Supervisor Training classes present valuable information. The regular "What's Behind the Trademark" turns to the pilot wheel of Pilot Freight Carriers. Copies of *Transmission Topics* may be obtained from the Fuller Manufacturing Co., Kalamazoo, Mich.

SAE Marine Unit

The Marine Propulsion Subcommittee of the Society of Automotive Engineers Powerplant Activity will hold its initial meeting at SAE's Summer meeting on June 8 in St. Louis at the Chase Park Plaza. The Marine unit will discuss marine diesel applications at an afternoon session under the chairmanship of W. J. Barta, executive vice president of Mississippi Barge Line Co. Papers scheduled include "Postwar Diesel Installations in the U. S. Navy," "Power for Pushing," and "Instrumentation and Techniques for Fuels and Lubricants Research."

New Sales Peak

Purolator Products, Inc., in their annual report to stockholders issued today, reported record sales of $48,349,971 in 1960. In making the announcement, James D. Abeles, President of this leading manufacturer of industrial and automotive filters, called attention to company expansion during the year which resulted in the establishment of two new plants. According to Abeles, the need for "on-the-spot" filtration engineering and manufacturing facilities for the aircraft industry was the prime reason for establishment of a new plant in Van Nuys, Calif. A new plant also was built in Creston, Iowa to specialize in the production of filters for the farm machinery and off-highway equipment markets. The $400,000 plant, which will eventually employ approximately 200 people, places the company in the midst of a market which has shown a constantly increasing demand for filters and elements.

Generator Bulletin

A new publication 254 describes a line of synchronous, alternating current generators rated 187 kva and larger produced by Electric Machinery Mfg. Co. The machines are "non-packaged," no voltage regulator is supplied. They feature dripproof construction, direct connected exciter, "thru greased" bearing, roomy terminal boxes and end to end ventilation. Electrically, the units are designed for low stator core loss. The generators are available in all standard voltages, 60 or 50 cycles, single or 3 phase. Single or two bearing construction is optional. Copies of bulletin 2100-PRD-254 are available from Electric Machinery Mfg. Co., Minneapolis 13, Minn. ITS NEW

Acquire Interest in French Piston Ring Firm

Perfect Circle Corp. has acquired a substantial financial interest in Floquet-Monopole, S. A., largest French manufacturer of piston rings, pistons, valves and sleeves. The announcement was made by William B. Prosser, Perfect Circle president, and Jean de Montremy, director general of Floquet-Monopole. Floquet-Monopole supplies original equipment to most vehicle and engine manufacturers in France and also is a major supplier of automotive replacement parts distributed through French jobbers. Perfect Circle piston rings will be manufactured under license by Floquet-Monopole on machines of Perfect Circle design, to be built in Europe.

Mid-West Diesel News

By L. H. Houck

TEN International DCOT-405 tractors for Orscheln Bros. Truck Lines, Moberly, Mo., with 195 hp Cummins diesels, Fuller T-233 10-speed transmissions, Ross steering gear, Timken axles.

H. J. G. Excavating Co., Benbrook, Tex., 43-M Marion dragline for work in gravel pit. It has 1½-yd. bucket, long tracks, and GM 6-71 diesel with Allison torque converter.

KOHLER model 15ROH61 15 kw diesel generating set for standby power for new weather station at Richards-Gebaur AFB, Grandview, Mo. Sale by AAA Engine & Electric, Inc., Kansas City, Kan.

THOMAS Quarry, Winchester, Ill., two 21000 Allis-Chalmers diesel power units for crusher operation in a rock quarry. Sale by Illinois Road Equipment Co., Springfield, who also made the installation.

GREEN Bay-Wausau Lines has installed a second GM 4-53 diesel in a Flxible bus. Both installations made by Inland GM Diesel, Inc., Milwaukee.

OCONTO County, Wis., highway department, has purchased a GM 6-110 power unit through Adams Machinery Co., for installation on a Cedarapids crusher. Sale by Inland GM Diesel, Inc.

DULIN Bauxite Co., Gypsum Div., Murfreesboro, Ark., International TD-15 with IHC diesel and Drott 4-in-1 front-end, for use as a skid shovel to supply raw material to crusher.

LAMBERT & Barr, Waldo, Ark., International TD-15 with Drott 4-in-1, for road cutting and clearing sites for oil well locations.

G. E. SMITH & Sons, Noble, Okla., five Euclid S-18 scrapers, two Euclid TC-12 tractors, two Euclid C-6 tractors from Butler-Sparks, Oklahoma City. Equipment in use on Tulsa-Bartlesville highway job near Ramona.

LITTLE ROCK Road Machinery Co., International TD-15 to Jimmy Patton, with Drott 4-in-1, for east side wrecking operations.

KOHLER standby electric plants protect eight sewage lift stations recently completed at Raytown, Mo. Seven have gas powered Kohlers ranging from 15 to 100 kw and the other is a 100 kw propane. Installation by Dutoit Construction Co., Kansas City, sale by AAA Engine & Electric, Inc.

AAA Engine & Electric, Inc. has delivered an 85 kw natural gas Kohler electric plant to the Iola, Kan., Allen County Hospital. Installation by Bachman Electric Co., Kansas City, Kan.

INTERNATIONAL TD-9 with 4-in-1 Drott front end to J. F. Butrum, Pine Bluff, Ark., from Little Rock Road Machinery Co., Little Rock.

INLAND GM Diesel, Inc., has delivered a 3-71 and a 4-71 GM diesel to Aring Equipment Co., Milwaukee for installation in Austin-Western motor graders.

WINGRA Stone Co., Madison, Wis., has taken delivery of a 6-71 GM diesel for installation in a heavy duty Diamond T machinery mover. Sale by Inland GM Diesel, Inc., Milwaukee.

SMITH Engineering Works, Milwaukee, has installed a GM model 4031C (4-71) diesel on a primary crushing plant for export. Sale by Inland Diesel, Inc.

POWER Chief 4-cycle Nordberg oil field diesels were an impressive part of the Nordberg exhibit at the Permian Basin Oil Show held in Odessa, Texas, recently.

NEW Case model 750 crawler tractor now on display at Mid-West dealers. It features a 301 cu. in. Case-built diesel, with Case Terramatic transmission and torque converter, producing up to 23,000 lbs., push-pull.

Equipment Leasing Study

A fourth edition of its study on equipment leasing has just been issued, it was announced by the Foundation for Management Research. Revised and expanded to 24 pages, the study is entitled: "The Pros and Cons of Equipment Leasing for Smaller Manufacturers, Department Stores and Supermarkets." A new section added advises business executives on renewals and options-to-buy at the end of the lease period, and examines the latest Internal Revenue Service rulings with regard to write-offs of payments on leased equipment. Included in the study are new tables and charts analyzing the comparative costs of leasing, outright cash purchase, purchase by conditional sales contract, and purchase through bank financing. Charts analyzing cash flow are also included. Specific situations where it is advantageous and disadvantageous to lease equipment are analyzed. Single copies of the fourth edition are available free to business executives by writing to the Foundation for Management Research, 121 W. Adams St., Chicago 3, Ill. (ITS NEW)

Inland River Reports

By A. D. Burroughs

AT St. Louis, the busy Humboldt Boat Service yard is active with the construction of a 50 x 18 ft. skyscraper-series towboat for Ohio River Dredging Co., W. Va. Twin Caterpillar D342 engines will supply 245 hp each at 1225 rpm.

THREE GM (Detroit) model 6-110's will equip a towboat, 55 x 22 ft., also under construction at the Humboldt yard. A third craft, nearing completion, will serve as Humboldt's own harbor craft, with power supplied from two GM (Detroit) model 6-71's.

A fourth Humboldt craft, delivered in late April to Keokuk Electro-Metals Co. (Iowa), is in active harbor switching duty. The 45 x 15 ft. vessel is powered with a GM 6-110 for a rated 220 hp.

BARBOUR Metal Boat Works, St. Louis, made delivery on the new twin-screw towboat, *Jay Gene*, to owners Eugene Luhr & Co., Columbia, Ill. The 54 x 20 ft. vessel receives a rated 670 hp from two GM (Detroit) model 12-71 engines.

OFFSHORE Crewboats Inc., Harvey, La. increased their fleet size with the new craft, *Ailine Elizabeth II*. Built by Equitable Equipment Co., New Orleans, the 54 x 15 ft. vessel has a rated 900 hp supplied from a pair of GM engines.

A number of big boats have hit the water, including the handsome new 4000 hp *John Ladd Dean*. Built by St. Louis Shipbuilding and Steel Co. for The Ohio River Co., the 164 x 40 ft. towboat has twin Fairbanks-Morse model 38D8½ non-reversing engines providing main pushpower.

A sister-craft to the big *John Ladd Dean* is the new *ORCO*, also completed by St. Louis Ship for Ohio River Co. service. The 4000 hp for this modern towboat comes from Nordberg engines.

A pair of Nordberg FS-138-HSC Supairthermal engines provide the rated 4320 hp for the new *Eugenie P. Jones*. Built by Dravo, the sleek new towboat is one of three new additions to the Canal Barge Line fleet.

SUSAN LANE, a sister craft to the *Eugenie P. Jones*, is receiving a fair share of praises from the performance for Canal Barge Lines, with the 4320 hp from two Nordberg engines.

SOUTHERN Shipbuilding Corp., La., delivered the new towboat, *Ned Merrick*, to Canal Barge Line, with a power rating of 3200 hp.

THE 110 x 30 ft. *Susan Ramsey*, completed by Greenville Manufacturing and Machine Works, is in service for RMR Towing Co. The attractive new towboat has a rated 2000 hp supplied from two GM (Cleveland) model 16-567-A engines.

THE *Eddie B* has a new 800 hp for performance for owners, Calumet Marine Towing Corp., Chicago, with repowering from a Superior engine (White Diesel Engine Division of The White Motor Co.) Material Service, Lockport, Ill., handled the installation.

CATERPILLAR engines develop the 600 hp for push-purposes for the new *Miss Nancy*, now in service for Missouri River Towing, Inc. The 66 x 24 ft. twin-screw towboat was built by Greenville Barge Construction Co.

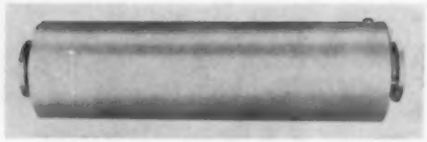
Capt. Ivan Monk Joins De Laval Steam Turbine Co.

Capt. I. Monk

Capt. Ivan Monk, USN (Ret.), has joined De Laval Steam Turbine Co., Trenton, N. J., as manager of the Service & Repair Department. He succeeded J. W. Robinson, retired March 31 after 49 years with De Laval. Capt. Monk was director of the Machinery Division, Bureau of Ships. He has also headed the BuShips aircraft carrier and turbine and gear branches, has been Design Superintendent of the New York Naval Shipyard and also was Chief Engineer of the USS Princeton and other ships. He holds the Legion of Merit and the Bronze Star.

New Line of Silencers

Engineering Controls Inc. is now manufacturing and marketing a line of commercial and residential dry silencers suitable for all internal combustion engines, according to an announcement by the company. Developed through extensive research and testing, they offer maximum silencing with minimal pressure drop through the unit.



The silencers, encased in a heavy gauge shell, have scientifically sized, spaced and perforated baffle elements in non-tuned design. They have been analyzed under service conditions throughout the full audible wave band to prove their noise attentuation. The silencers are available on order with a wide variety of corrosive resistant coatings inside and out. The standard exterior coating is heat resistant metallic that becomes an integral part of the metal when heat is applied. For further information write to Engineering Controls Inc., 611 East Marceau, St. Louis 11, Mo.

ITS NEW

A-C Unveils New Models

Large groups of heavy construction contractors, Allis-Chalmers dealers and press representatives from United States and Canada, buoyed by signs of a national upswing in construction business,

attended Allis-Chalmers huge "Power Parade" machinery exhibit in Springfield, Ill. Company officials told almost 1,000 dealer, company and press representatives at the opening of the "Power Parade" that there are "good signs of a rise" in the construction business. The dealers and the press inspected a fast-moving mobile display of 50 different models of new Allis-Chalmers construction equipment. Then groups of contractors accompanied by dealers came the following week. The new Allis-Chalmers yellow units, ranging in size from 6,000 to 100,000 lbs., were on display at the firm's plant here along with a 500-ft. long tent full of exhibits and cut-away models. Major new models on display included: an experimental 700 hp dual-engine motor scraper capable of scooping up and hauling 40 cu. yds. of dirt in a load; a big tractor loader (TL-30) with a lifting capacity of 25,000 pounds; a huge tractor shovel (HD-21G) weighing 73,000 lbs., and specially designed for steel mills' slag removal operations; a medium sized, 105 hp motor grader (145-T), and a new "small" motor scraper (TS-160) with a 13-ton carrying capacity.

Advanced Planning Vice President

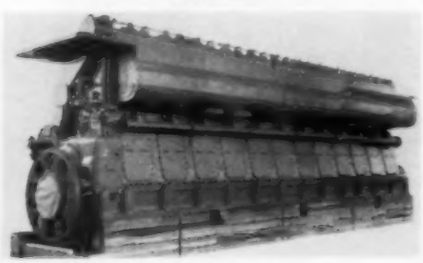
R. L. Boyer

R. L. Boyer, formerly vice president and director of engineering of The Cooper-Bessemer Corporation, has been promoted to vice president of advanced planning for the corporation, according to E. L. Miller, president and general manager. Mr. Boyer will devote his full time to advance product planning, and will work with Mr. Miller and J. E. Brown, C-B's vice president and treasurer, in studying products that can further contribute, by acquisition, to C-B's diversification program. Through this latest step in its 10-year growth plan to quadruple sales, the company will greatly intensify its effort both to develop new products within the firm, and to develop new markets by acquisition of existing product lines. D. L. Gallogly, C-B's chief engineer, succeeds Mr. Boyer as operating head of the Engineering Department. W. R. Crooks, now a consulting engineer to Cooper-Bessemer, and J. F. McShane, turboproducts engineer, will report to Mr. Boyer as project leaders on his staff.

138 Ton Giant for Thibodaux

It took four railroad flat cars—one of them of the rare 8-axle variety—to deliver a 138 ton Fairbanks-Morse slow-speed stationary diesel engine, plus blower, flywheel and miscellaneous parts, to Thibodaux, La. The story of the early February delivery goes back to last October, when the 4200 hp mammoth was still under production in Beloit, Wis. F-M's traffic department went to the "initiating line"—the Milwaukee Road, first railroad on the route—with a request to secure clearances so that no bridge or other obstacle would impede the journey. "There are only some three to five cars in the United States able to handle an engine of this weight and size," Perry G. Jefferson, Fairbanks-Morse traffic manager, said. "Many can carry the weight but they have a well design; only a few can handle so much weight plus the 36-ft. length of the engine. Fortunately we were able to get a direct route in this case. Sometimes we have to circle half way around the country to deliver one of these engines." The Milwaukee Road handled the shipment from Beloit to Kansas City. The Missouri, Kansas and Texas—Texas and New Orleans lines took over from there. The 8-axle flat car carried the engine, which weighed in at 108 tons, having been "lightened" 30 tons by the removal of the 12-cylinder liners, along with their connecting rods and pistons. K. A. Taylor, in charge of the order department in Beloit, said that the car could have carried the load, but that the weight reduction was made to assure easier handling upon arrival at Thibodaux. A second flat car carried the cylinder liners; a third transported the alternator, and the fourth handled the blower, flywheel and such items as hand rails and platforms. This is the fourth Fairbanks-Morse model 31AD18 engine in an all-new municipal power plant at Thibodaux. The other three were 8-cylinder units, 2800 hp each.

This engine, mounted for shipment, is the Fairbanks-Morse Model 31AD-18. It is of the 2-cycle type with an 18-inch bore and 27-inch stroke, and delivers 4200 HP at 277 RPM. It runs on fuel oil or natural gas, and drives a 3000 KW three-phase 60-cycle 13,-800-volt alternator, belted to a 30 KW exciter.



Central Region Manager

James J. Clarke has been appointed manager of the Central Region of the Commercial Sales Division, American Bosch Arma Corp. Central Region headquarters are in Cleveland, Ohio. Mr. Clarke was formerly merchandising manager of Winchester-Western Division of Olin Mathieson Co. in New Haven, Conn. Prior to his association with Winchester-Western he had been with Magill-Weinsheimer Company of Chicago.

Mine Personnel Carrier

A new personnel carrier for underground mining has been developed by the Getman Brothers of South Haven, Mich. The new unit, which is now in production, is the latest addition to the extensive line of Getman equipment used in construction, mining and other industries. It is powered by a Deutz air-cooled model F2L 712 diesel engine. The new carrier, which can be adapted to a utility truck, can be used in low headroom mines as well as in high clearance areas. It is equipped with the Getman approved type scrubber, has 7:50 x 16–8 ply traction type tires, four wheel hydraulic brakes, 12 volt lighting system and Delco Remy low cut-in generator of high capacity. The personnel carrier, with speeds up to 20 miles an hour, has a carrying capacity up to 5,000 pounds.

ITS NEW

Newlin Heads AED

R. F. Newlin

Richard F. Newlin, president of Newlin Machinery Corp., Kansas City, Kans., has been elected international president of Associated Equipment Distributors, national trade association of the construction equipment industry. Newlin was installed during AED's 42nd annual meeting in Los Angeles. Last year Newlin was AED senior vice president and, in 1959, he was vice president. In 1958, he served on the Association's board of directors, representing distributors from Iowa, Kansas, Missouri and Nebraska.

American Bosch Service Manager

Chet Hirsch

Appointment of Chet Hirsch as manager of Service and Training for the Commercial Sales Division of American Bosch Arma Corp., Springfield, Mass., has been announced. Mr. Hirsch joined the Commercial Sales Division last year as assistant manager of Service and Training. He was formerly associated with Allen Electric Co. of Kalamazoo, Mich. as service manager.

New Heavy Duty Tractor

A 14,000 lb. heavy-duty tractor for over the road use has been announced by Marmon-Herrington Company, a pioneer in the field of all-wheel-drive vehicles for military and industrial use. The model shown is one of several that have been on road test in the fleets of large common carriers. It has a wheelbase of 132 in., and a maximum gross combination weight of 72,000 lbs. Engine is a Cummins NH-220, naturally aspirated. Marmon-Herrington is aiming for a sales goal of 1,500 annually. The truck will be built at the main plant in Indianapolis, Ind., where the firm's Oneida School Bus Division is located. Unit is equipped with Fuller RoadRanger R96, 10-speed transmission, Spicer 1700 propeller shaft, Timken TK-571 forward rear axle and Timken R-140 rear driving axle.

New Caterpillar Positions

L. L. Morgan

Caterpillar Tractor Co. has announced appointment of three executives to new positions upon the retirement of two vice presidents. The changes are effective June 1. Retiring are Vice Presidents Henry H. Howard, in charge of the Company's Engine Division, and Gail E. Spain, who has had administrative responsibility for foreign marketing. Lee L. Morgan will succeed Mr. Howard as vice president in charge of the Engine Division, and also assume administrative responsibility for the company's Defense Products Department. Vice President W. J. McBrian will succeed Mr. Spain and also become president of the subsidiary companies, Caterpillar Americas and Caterpillar of Delaware. Since 1956, Mr. McBrian has been chairman and managing director of Caterpillar Tractor Co. Ltd., the company's subsidiary in Great Britain. E. C. Chapman, assistant Sales Development manager, will succeed Morgan as manager of Sales Development. Chapman has been with Caterpillar since 1945, and has held a variety of sales and advertising positions since that date. Since joining the Company in 1946, Mr. Morgan has supervised various advertising, sales and sales development functions and was named manager of Sales Development in 1958. He was elected a vice president at the Board of Directors meeting on March 28. Mr. Howard joined Caterpillar 35 years ago, and for many years held responsibilities in the sales management field. He became manager of the Engine Division when it was formed in 1953 and was elected a vice president in 1954.

W. J. McBrian

E. C. Chapman

Natural Gas Electric Set

Lone Star Gas Co. is supplying electrical power for their Springtown, Tex. gasoline plant from a recently installed Caterpillar G342 Series C natural gas electric set. Fuel for the new electric set is obtained from gas produced in the plant. The electric set will sustain a continuous load of 125 kw to provide power for the plant lighting system, cooling tower fans, process pumps, induced draft boilers and other equipment used in distilling commercial gas products from raw field gas. The electric set package was engineered for this installation by Darr Equipment Co., Dallas. The engine will produce 200 hp at 1200 rpm, but is capable of producing 250 hp at 1300 rpm. This unit has an Electric Machinery Mfg. Co. 440 volt, 3 phase, 60 cycle generator with a 440 volt ac starter. Set is also equipped with a special natural gas engine governor, the Woodward UG8.

Form Defense Units

Formation of the Defense Materiel and Defense Systems departments under the respective managements of R. R. Walker and Ray Bell has been announced by Allis-Chalmers Defense Products Division. In addition, A. J. Bennett has been appointed assistant to the general manager of the division. Walker had been sales manager of the Defense Products Division since 1959. Bell came to Allis-Chalmers in 1936 and has been Contract Administrator for the company's Atomic Energy Division "C Stellarator" project. Bennett, who had been administrative assistant to the sales manager of the Defense Products Division, came to Allis-Chalmers in 1944.

Michigan-Ohio News

By **Jim Brown**

WILLIAM J. Muehlenbeck, Inc. of Saginaw, Mich. has accepted delivery on a new Hough H-120 payloader powered by an International diesel engine. Sale was made by Wolverine Tractor and Equipment Co. of Detroit and Grand Rapids.

PENINSULAR Diesel, Inc. of Detroit has installed a GM 5037-7242 diesel engine in a new "Apache" Chevrolet truck. The installation was done for International Salt Co. of Detroit.

O. E. Gooding of Ypsilanti, Mich. has accepted delivery on a Koehring model 605 crane. The new crane is powered by an Allis-Chalmers diesel model 16000 and was purchased from Earle Equipment Co. of Detroit.

MILLER Equipment Co. of Livonia, Mich. recently sold a Huber-Warco model 11D to Monroe County Road Commission. The new grader is powered by a Cummins H-6-BI diesel engine.

BERT Myers of Big Rapids, Michigan has accepted delivery on a new International TD-15 with hydraulic bulldozer. The new tractor was purchased from Wolverine Tractor and Equipment Co. and will be used in general construction and road work.

PENINSULAR Diesel, Inc. installed a GM 5047-5243 diesel engine in a Ford F-800 (replacing gasoline) for Lester Klair of Pontiac, Mich.

PRESQUE Isle Corporation of Alpena, Mich. has accepted delivery on an Allis Chalmers HD-21 crawler tractor. The unit was purchased from Earle Equipment Co. and will be used to stockpile coal, feed hoppers, conveyors, etc.

APPOINTMENT of Roy Pandow as vice president and general sales manager of the R. G. Moeller Co. in Grand Rapids has been announced by Charles Garretson, president. Mr. Pandow joined the Moeller organization in 1948 and for the past six years has been sales manager in the company's Detroit office.

JOHN B. White of Alpena, Mich. recently purchased a Cummins NHC-4 diesel marine engine for installation in a fishing boat. A Twin Disc marine gear model MG-165 with a 2-to-1 ratio was used.

A 3¼-yd. Michigan model 175A front end loader was recently delivered to the S. E. Hayes Sand and Gravel Co. of Northville, Michigan. The new Michigan tractor-loader is powered by a 162 hp Cummins C-175 diesel engine and was purchased from Miller Equipment Co.

CASS County Road Commission of Cassopolis, Mich. has accepted delivery on a new International TD-15 crawler tractor with bulldozer blade and winch attachment. The sale was made by Wolverine Tractor & Equipment Co.

PAUL Maynard of Sandusky, Mich. has accepted delivery on a GM model 3057C to install in a Gar Wood 302 trencher (replacing gasoline). The engine was sold by Peninsular Diesel Inc.

EARLE Equipment Co. has sold an Allis-Chalmers model HD11 crawler tractor to the L. W. Edison Co. of Grand Rapids, Mich. The new A-C tractor will be broken in on a highway project near Charlotte, Mich.

CUMMINS Diesel Michigan Inc. recently installed a Cummins NTO-6-B in a Mack Truck B-83 tandem for Paul Jones of Ferndale, Mich.

MILLER Equipment Co. of Livonia recently delivered a Huber-Warco 8-12 ton tandem roller to the Ann Arbor Construction Co. of Ann Arbor, Mich. The new roller is powered by a GM 2-71 diesel engine.

JACK Dykstra of Grand Rapids, Mich. has accepted delivery on an International Model TD-15 tractor with bulldozer. Sale was made by Wolverine Tractor and Equipment Company.

PENINSULAR Diesel Inc. installed a GM model 5034-7201 diesel engine in a Michigan C-16 crane (replacing gasoline). The installation was done for Franklin Iron and Metal Co. of Battle Creek, Michigan.

CYRIL J. Burke Inc. of Detroit has been appointed as an Austin-Western distributor for the eastern half of the lower state of Michigan. The A-W line will include graders, rollers, sweepers and hydraulic cranes.

C. L. C. Trucking at Clarkston, Mich. has accepted delivery on a Hough model H-120 Payloader powered by an IH-17 diesel engine. The sale was made by Wolverine Tractor and Equipment Co.

PENN-Dixie Cement Co. of Petoskey, Mich. has accepted delivery on a new Cummins HRS-6-BI to repower an Autocar quarry truck. Distributor: Cummins Diesel Michigan Inc. of Dearborn, Mich.

Florida Diesel News

By Ed Dennis

AFRICAN Rivers Lines will take delivery of the new *Ituri*, Miami-Bahama Island freighter. Two Caterpillar D343, aftercooled-turbocharged, with Cat 2:1 r & r gears are rated 300 cont hp each at 1800 rpm; were engineered and supplied by Shelley Tractor & Equipment Co.

A GM 6-71 diesel engine powers the GMC 86 highway tractor for Belcher Oil Co., Miami, used to pull an 8000 gal. tank trailer. Also included is a Spicer five speed transmission and Eaton two speed rear axle.

MARINE Engine Equipment Co. at West Palm Beach replaced a six cylinder gasoline engine with a model OM 636 Mercedes-Benz diesel and Paragon 2:1 r & r gears. The diesel, rated 36 hp at 3000 rpm, was installed in the 34 foot motor sailer, *Liza Davis*.

MIAMI Br. Detroit Diesel Div. supplied a GM model 4-53, rated 98 hp at 2200 rpm, for installation in a citrus grove speed sprayer for Lykes Bros. of Lake Placid and a similar installation for S. Y. Hartt & Sons of Avon Park.

AMONGST the dieselized equipment used by the San Marco Contracting Co. near Clewiston were two Allis-Chalmers HD-21 crawler tractors for dozing and pushloading. These are powered by Allis-Chalmers turbocharged 21000 diesel engines rated 225 hp.

MARINE Electrical Service, Inc. of Miami, has been appointed dealer for the Westerbeke dieselized generating sets for South Florida. These sets combine the Westerbeke model Four-99 diesel engine and a 10 kw Onan generator.

LISTER-Blackstone, model SL1, dieselized Winn-power 2½ kw generating set, engineered by Shelley Tractor & Equipment Co., for the R. G. Somers farm at Goulds.

SIX, 65 foot, ice breaking tugs will be constructed by the Gibbs Corp. at Jacksonville for the U. S. Coast Guard. They will be powered by a single D375 Caterpillar marine diesel and 3:1 r & r gears. The Cats are rated 400 hp at 1200 rpm.

WE saw the newly installed, standby, Superior (White Engine Div.) diesel engine, model 40 SX 8½ x 10½ rated 556 hp at 880 rpm, which powers a Worthington 15 mgd pump at the 67th Street pumping station of the Miami Water Dept.

ANOTHER Cummins dieselized 400 cycle ground power unit for Pan American Airways, Miami. A Cummins C-160-BI rated 122 hp at 1714 governed rpm, provides power for the 173 amp 115/200 volt 48 kw 60 kva Motor Generator Corp. generator.

UP near Orlando the A. J. Capeletti, Inc. contractors are using several pieces of GM dieselized equipment among which are six Euclid S12 scrapers powered with GM 6-71, 218 hp, diesel engines, three Euclid bottom dumps and a C6 Euclid tractor.

FOR the Marine Laboratory, University of Miami, a new type 35x16 foot catamaran which draws only 15 in. of water, to be used as a floating classroom at places of sea location. To be powered by a pair of Caterpillar D320 diesels with aftercooler and turbochargers.

AN International-Harvester, TD-25 crawler, powered with an International 230 hp turbocharged diesel is being used by Alonzo Cathron up near La Belle on road construction work, to push load two T-55 International Payscrapers.

ELLIS Diesel Sales & Service at Fort Lauderdale installed a 3 kw Onan diesel generating set on the *George W* of the same city.

VISITED the 107 ft. *Cariban*, a West Indies fruit vessel operated by Banana Supply Co. It is powered by two six cyl model 320 Atlas diesel engines. For electrical power a 40 kw Caterpillar and a 25 kw Hercules dieselized generating sets are used.

JACKSONVILLE Br. of Detroit Diesel repowered the *Cathy-Ann*, a 35x11½ ft. fishing vessel, of Bradenton, with a pair of General Motors 6-V-53 marine diesel engines and 2:1 Borg Warner gears.

M. V. Stratford, a 201 ft. West Indies freighter, carrying freight to Panama and bananas from Ecuador, has for power two model GBS eight cylinder turbocharged Cooper-Bessemer diesels each rated 710 hp at 600 rpm. Two D364 Caterpillar V-8 diesel engines supply power for the 240/480 145 kva 435-218 amp GE generator.

LAUDERDALE Lakes Utilities received from the Miami Br. Detroit Diesel, one GM 2-71 diesel engine (44 cont. hp at 1800 rpm) and two 3-71's each rated 67 cont. hp, to power three Fairbanks Morse water pumps.

TWO 68x26x3 ft. pile driver barges will be built by the Gibbs Corp. at Jacksonville for the U. S. Coast Guard for buoy tending. Each will mount a Bay City crane for the piledriver hammer. A GM 3057 diesel will power each unit.

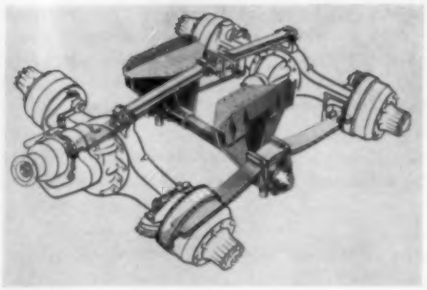
FROM Cummins Sales in Hialeah, we hear about the rock crushing plant operated by M. G. O'Niell at Alva. A Cummins HRC-4 on their 50 kw Marathon generator and a Cummins NHRS to power the 150 kw Marathon generator in the crushing plant.

LeT-W Unit Has 8V-71

The LeTourneau-Westinghouse model C Tournapull now has 290 hp. The GM V-71 engine output has been increased to 290 hp by changing the injectors from 55 mm to 60 mm. This produces the 290 hp @ 2100 rpm with maximum torque of 805 ft. lb. @ 1200 rpm.

Tandem Suspension System

A minimum weight suspension with the rideability possible only with long leaf springs are two of the many features claimed for a new tandem suspension system developed by Rockwell-Standard. Trucks equipped with this new exclusive "Taper-Leaf" suspension, it is said, can carry up to 434 pounds more payload with a cushioned, more comfortable ride whether the truck is fully loaded or empty. With this new design, each spring consists of but two leaves of equal length. In these leaves, the thickness at the center is increased to the point where the section modulus, or bending strength, is equal to that of a multi-leaf spring. Each leaf then tapers gradually toward the ends keeping the same strength as a multi-leaf spring. This Taper-Leaf Suspension, according to Rockwell engineers, achieves the same load-carrying capacity with two leaves that standard suspensions carry with multiple leaves with a savings in weight. Another advantage of this new spring design, it is said, is the fact that a spring with only two leaves more closely approaches the theoretically perfect leaf spring than does a multi-leaf spring because of its uniform stress characteristics. Equipped with aluminum brackets and torque rods, which are optional equipment with this new suspension, a further reduction in weight may be achieved. Literature about this new tandem suspension system may be obtained by writing Rockwell-Standard Corp., Transmission and Axle Division, Detroit 32, Mich. (ITS NEW)

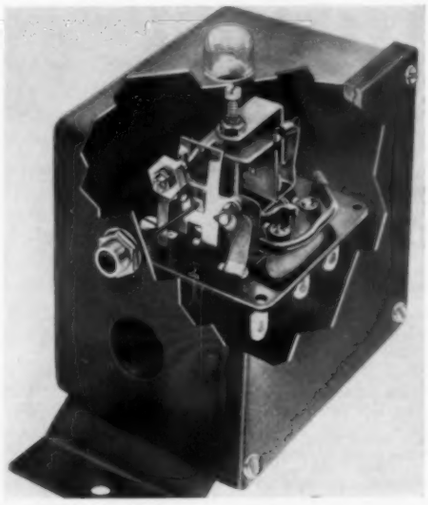


Elliott Regional Manager

Elliott Company, Jeannette, Pa., has announced appointment of Harlan P. Hostetter as Western Regional manager, with headquarters in San Francisco. Prior to this new appointment, Mr. Hostetter served as San Francisco district manager. Mr. Hostetter joined Elliott in 1941. He was a pilot in the U. S. Navy from December 1942 to November 1945 during World War II. Returning to Elliott in 1946, he gained experience as a field engineer in various district offices throughout the country. Mr. Hostetter was appointed district manager in 1956.

H. P. Hostetter

Vibration and Shock Switch



A new vibration and shock switch has been announced by the Frank W. Murphy, Manufacturer, Inc. The switch is sensitive to abnormal oscillation in two plane of motion and has infinite sensitivity adjustment. The VS-1 and VS-1C models are the same except that the latter has a "C" clamp for mounting on pumping unit frame. The units are field adjustable and are designed for use on engines, pumps, pumping units, compressors and other equipment subject to destructive motion. For more information write the maker at Ranch Acres Station, Tulsa, Okla. (ITS NEW)

F-M International Manager

G. E. Millar

George E. Millar has been appointed general manager of the International Division of Fairbanks, Morse & Co., with headquarters in Fair Lawn, N. J. He succeeds Pier F. Talenti, who resigned to join a construction engineering firm owned by his family. Millar joined Fairbanks, Morse nearly 15 years ago, and since last January has been manager of export sales. Previously he had been manager for all product sales in Africa and the Far East. Before that he handled diesel engine and pump sales and applications.

B&W American Vice President

W. J. Pierce

William J. Pierce has been promoted from controller to vice president of the Burmeister & Wain American Corp. The marine diesel engine manufacturer maintains a manufacturing plant for the B&W-Lathrop engines and its headquarters at Mystic, Conn. Mr. Pierce joined the company at New York City in 1954.

Opens New Test Facility

Darr Equipment Co., Dallas Caterpillar dealer, is offering a complete sales, engineering, testing and service facility for diesel engine-generator packages up to and including 400 kw-240/480 volt units. The testing equipment will operate under full load conditions with any make engine-generator package of this power class or below. Recording meters are used in the testing procedure at Darr, to give a positive means of checking frequency and voltage modulation, regulation and recovery on load application, rejection and stability. The Darr test facility is presently being used to test a group of Caterpillar D333 electric sets with Electric Machinery Mfg. Company produced Switchgear lineup for each three units. The D333 engine generator packages also include Electric Machinery Mfg. Co. 3 phase, 60 cycle, 120/208V, 100 kw generators rated at .8 pf at 1800 rpm. The engines are under complete remote control from the switchgear. They can be started, stopped, reset, paralleled and synchronized at the control panel. The control system is also equipped with a governor control, electrically operated circuit breakers, glow plugs and battery charger.

ADVERTISERS' INDEX

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Wichita Clutches

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Wichita controlled Slip Clutches provide more flexible power for "Rockland County".

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WICHITA Clutch COMPANY, INC.

WICHITA FALLS, TEXAS, U.S.A.

Write for Wichita Clutch general catalog.

Left to right: Benjamin Groebner, Chief Engineer of Sleepy Eye power plant; George Stinedurf, Service Engineer, Cooper-Bessemer; Clair Howell, Howell Bros.

Sleepy Eye is wide awake to proved economies

Sleepy Eye is a town in Minnesota that is anything but sleepy. They bought a Cooper-Bessemer LS-8 supercharged engine . . . 2120 hp for 1500 kw service. Proved by millions of operating hours, rugged LS engines have an outstanding record for reliable, low-cost performance.

Thus, engineers of Sleepy Eye *knew* what they were getting when they decided on this proved power unit to meet the growing needs of their utility.

This Cooper-Bessemer gas-diesel engine is equipped with Turbocooler to increase its efficiency.

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2